1743

Roger Scott 5819

RESEARCH AND TECHNOLOGY BRANCH — 1990 - 91

Report on Environmental Research, Technology Development and Awareness Activities 1990-91

25/11/91

Environment
Environnement
Ontario

This paper is unbleached and
contains 100% post-consumer fibre

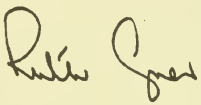
PIBS 1743E
ISBN 0-7729-9117-0

Foreword

It gives me great pleasure to present this record of environmental research, technology development and awareness activities in the year April 1990 to March 1991. Focussed entirely on the Research and Technology Branch of the Ontario Ministry of the Environment, it provides a comprehensive overview of the external support programs coordinated through the branch, as well as other branch initiatives and activities that support the mandate of the ministry.

I acknowledge and applaud the contribution to enhanced environmental quality made through the efforts of the many public and private researchers, industry, and the individuals, groups and companies whose initiatives are documented in this report.

This represents the first edition of the Report on Environmental Research, Technology Development and Awareness Activities. It will be updated annually. I hope there will be many items of interest to you in this report, and that it will serve both as a useful educational document and a valuable reference source.



Ruth Grier
Minister

October, 1991

Contents

Importance of Environmental Research, Technology Development and Awareness 5
The Research and Technology Branch 7
Environmental Research Program 9
Final Reports of Environmental Research Program Projects 63
Excellence in Research Awards 73
Environmental Technologies Program 77
Miscellaneous Grants 87
Funds from the Cleansweep Lottery 101
Technology Transfer 111
Future Directions 113
Keyword Index (Research and Technology Development) 115
Keyword Index (Awareness) 123

This report contains summaries of all active research, technology development and awareness projects coordinated through the Research and Technology Branch, Environment Ontario in the period, April 1990 to March 1991. For more detailed information on any project, please contact the branch at (416) 323-4574.

Summaries of research and technology development projects contained in this report should not be cited without the permission of the Research and Technology Branch, Environment Ontario.

Importance of Environmental Research, Technology Development and Awareness

New developments in all areas of science and industry are occurring at a tremendous rate. Innovative products, materials and industrial processes are constantly appearing. Developments in these areas can affect the environment by introducing new contaminants, creating new waste management issues, or by overloading the capacity of existing systems.

To deal with such issues requires a strong commitment to ongoing research and technology development programs. Such programs support the activities of university and private researchers, environmental protection companies and industry in providing the knowledge and systems necessary to address these concerns.

In conjunction with these scientific and technological endeavours, there remains the ongoing necessity for increasing public awareness of environmental issues. Whether achieved through publications, videos, stage performances or forums, public environmental literacy is fundamental to the resolution or avoidance of such concerns.

These technical and educational ventures work in parallel towards a common objective, enhanced environmental quality. It is through such initiatives that the environmental problems of the past can be remediated, those of the present diminished, and those of the future averted.

The Research and Technology Branch

Mandate

Environment Ontario's goal is "to protect and enhance the quality of the environment for the present and future well-being of the people of Ontario and of the ecosystem in which they live." In recognition of the increasing importance of environmental research and technology development in fulfilling this mandate, the Research and Technology Branch (RTB) was created in 1988.

The RTB ensures that the ministry remains at the forefront of knowledge and skills in environmental management and technology. Its primary role is to coordinate and promote internal and external research projects of the ministry and foster the development of innovative environmental protection technologies. More recently, support for public awareness activities has assumed increased importance.

Responsibilities

During the year, the RTB had responsibility for four programs:

- Environmental Research Program
- Environmental Technologies Program
- Tire Recycling Technologies
- Miscellaneous Grants

In addition, the branch coordinated the distribution of funds from the Cleansweep lottery to various environmental projects

An increasingly important responsibility of the RTB is to communicate developments and the results of research, and to encourage their implementation in the community. To date this has been done mainly through the annual Technology Transfer Conference. During the year, this technology transfer initiative was expanded to strengthen liaison with research organizations, technology based groups and other agencies to ensure the transfer of new technologies and information from the government to the private sector.

In performing its role, the RTB promotes and supports the environmental protection industry in Ontario, and ensures that a wide range of talents and information is available to the ministry for developing policy and regulations.

Staff

Director

Mrs. Helle Tosine

As Director, Helle is charged with the responsibility for the definition of branch priorities and direction, and the development and implementation of strategies, programs and alliances for the effective delivery of its mandate. Helle represents the branch and the ministry on a number of committees including the Canadian Council of Ministers of the Environment Environmental Protection Committee (Chair) and the provincial University Research Incentive Fund. She also chairs a number of ministry committees including both the Research and Environmental Technologies Advisory Committees.

Senior Research Advisor

Dr. Mike Moselhy

Mike has provided advice and prepared many ministry reports on research management, needs and policy since joining the branch's forerunner, the Research Management Office, in 1982. He also plays an inte-

gral role in the organization of the annual Technology Transfer Conference. In 1990, Mike received a Special Staff Achievement Award for his long-term dedicated service in support of the Environmental Research Program and the Technology Transfer Conference.

Manager, Research Coordination
Mr. Joel Kurtz

Joel's primary responsibility is the coordination of the Environmental Research Program. Apart from administrative management for this program, Joel is involved in the development of guidelines and policies for its efficient functioning. More recently, he has been coordinating the streamlining and integration of the branch's information and reporting systems.

Manager, (Acting) Environmental Technologies Development
Mr. Doug Vallery

Doug's major responsibility is the management of the Environmental Technologies Program. This includes the supervision of program delivery as well as program promotion, project monitoring and liaison with industrial and institutional clients.

Coordinator, Environmental Grants and Technology Transfer
Ms. Sharon Suter

Sharon's responsibilities encompass both branch technology transfer activities and coordination of the Environmental Education and Awareness Program. Sharon also plays a significant role in the organization of the annual Technology Transfer Conference in her capacity as Chair of the Organizing Committee.

Ms. Suter is currently on maternity leave. Acting Coordinator, Environmental Grants and Technology Transfer, is Ms. Jan Woelfle.

Environmental Technologies Analyst
Ms. Tammy Lomas

Tammy's responsibilities include coordination of the Environmental Technologies Program and the development of policies and guidelines for its operation.

Ms. Lomas is currently on maternity leave. Acting Environmental Technologies Analyst is Mr. Matt Uza.

Acting Research Assistant
Mrs. Valerie Desautels
(currently Acting Executive Assistant to the Assistant Deputy Minister, Environmental Planning & Prevention Division)

Secretary to the Director
Mrs. Barbara Kusznir

Grants Assistant
Mrs. Ana Rosati

Wordprocessing Technician
Ms. Valentina Gonsalves

Research Project Officer
Dr. Roger Scott

Research Assistant
Ms. Connie Marano

Grants Coordinator
Ms. Nadia Kuzmitsky

Technology Assistant
Ms. Kirsten Mania

Environmental Research Program

Environment Ontario encourages excellence in environmental research through its Environmental Research Program (ERP). Since 1977, this program has supported 591 research projects at universities, private laboratories and public agencies.

Research projects conducted within the ERP fall into six broad categories:

- air quality
- water quality
- liquid and solid waste
- analytical methods and instrument development
- environmental socio-economics
- multimedia contaminants and biotechnology

Overall responsibility for the ERP exists with the ministry's Research Advisory Committee (RAC), which establishes priorities and ensures that research activities are consistent with ministry policies and objectives.

The ERP makes a significant contribution to the support of environmental research not only through its funding activities, but in its encouragement of links between the ministry and the scientific community. It facilitates access to a broad range of expertise and resources, and provides opportunities for synergistic links between ministry scientists, and universities and consultants, in solving environmental problems.

THE ERP PROCESS

Each year, coordination of the ERP requires three main activities: identifying research priorities, evaluating proposals and allocating funds, and completing the administrative and reporting process.

Each November, with help from the branches and regions, the RAC prepares a document entitled "Research Needs," which summarizes the ministry's long-term needs in the six research categories. Researchers are then invited to submit funding applications addressing these defined needs.

Deadline for receipt of proposals is January 15 each year. Submissions must include objectives, experimental protocol, anticipated achievements and a detailed budget. The relevance of the proposed research to ministry activities and needs must be clearly stated.

Technical review of applications is conducted within six weeks. This process is overseen by Research Coordinators, each responsible for one of the six research areas. This review, and recommendations of the RAC, are based on such criteria as:

- scientific merit
- competence of the researcher and quality of facilities
- likelihood of achieving objectives on time
- cost relative to the anticipated benefits
- compatibility with ministry needs and priorities
- potential for implementation of results

Based on these evaluations, as well as research priorities and available funds, applications are recommended by the RAC to

senior management for approval or rejection. Final approval may depend on changes to the budget or the research protocol.

Projects are then assigned a ministry Liaison Officer whose responsibility is to monitor technical progress. A close working relationship between the Liaison Officer and researcher is a great help to the ministry in including research findings into its programs and activities.

Researchers must provide interim reports on the project, and a final report upon completion. During the course of the project, funds are released upon the provision of acceptable progress reports. Researchers may also be required to deliver at least one presentation at the annual Technology Transfer Conference.

Research Advisory Committee Members

Mrs. Helle Tosine
Director, Research and Technology Branch

Mr. Don Bartkiw
Director (Acting), Waste Management Branch

Mr. John Bray
Director, Approvals Branch

Dr. Walter Chan
Coordinator, Acid Precipitation Office

Mr. Carl Griffith
Director, Fiscal Planning and Economic Analysis Branch

Dr. Freeman McEwen
Chairman, Pesticides Advisory Committee

Mr. Ed Piché
Director, Air Resources Branch

Mr. Gerry Rees
Assistant Director, Water Resources Branch

Mr. Ken Richards
Coordinator, Intergovernmental Relations Office

Mr. Wayne Scott
Director, Northwest Region

Mr. Kim. Shikaze
Regional Director — Ontario Region, Environmental Protection Service, Environment Canada

Mr. Serge Villard
Director (Acting) Laboratory Services Branch

With the noted exception, all personnel are affiliated with the Ministry of the Environment.

Research Coordinators

The success of the ERP is due in no small way to the enthusiasm and dedication of the Research Coordinators. Their role is to oversee the technical review of all submitted research proposals that fall within their particular research area, and to present the results of this to the Research Advisory Committee for discussion.

The Research Coordinators also assist in the ongoing support of funded research projects either directly, or in cooperation with project Liaison Officers. This helps ensure successful completion of projects and the timely integration of results into ministry programs where appropriate. They also play an important role in formulating the program content for the annual Technology Transfer Conference.

The following lists the Research Coordinators for each of the research categories.

Air Quality

Dr. Neville Reid

Dr. Reid is Supervisor of the Special Studies and Research Management Unit in the Air Resources Branch. Unit activities include operating the provincial acid and toxics deposition monitoring networks, and directing the operation of several networks monitoring airborne toxic chemicals in both urban and rural areas of Ontario.

Water Quality

Mr. Wolfgang Scheider

Mr. Scheider is the Supervisor of the Bioassessment Unit in the Water Resources Branch. Among the responsibilities of this unit are the production of the "Guide to Eating Ontario Sportfish", a variety of related biomonitoring programs, the development of surface water and sediment quality guidelines and the operation of a laboratory sediment bioassay facility.

Liquid and Solid Waste

Mr. Mel Fielding

Mr. Fielding is Coordinator of Technology Transfer for the Waste Management Branch. In addition to his role in both the Environmental Research and Environmental Technologies Programs, he coordinates branch reviews and comments for environmental assessments and ministry policies and guidelines in general.

Analytical Methods and Instrument Development

Dr. Ray Clement

Dr. Clement is a Research Scientist with the Laboratory Services Branch, and is responsible for planning and reporting on analytical methods research within and external to the branch. He is also engaged in several projects relating to the analysis and environmental distribution of chlorinated dioxins/furans. Dr. Clement has authored or edited 4 books and 90 research papers, most of which deal with the challenges of environmental trace organic analysis.

Environmental Socio-Economics

Ms. Orna Salamon

Ms. Salamon is a Project Coordinator in the Socio-Economics section of the Fiscal Planning and Economic Analysis Branch. Ms. Salamon has conducted many studies related to the valuation of environmental remediation efforts and is currently involved in a variety of initiatives including waste management and the 3R's. Among her interests are the design and application of economic instruments to achieve provincial environmental objectives.

Multi-Media Contaminants and Biotechnology

Dr. Roland Weiler

Dr. Weiler is the Coordinator of Special Studies and Research with the Hazardous Contaminants Branch. Besides his work for the Research Advisory Committee, he is coordinating the branch effort in projects dealing with exposure and risk assessment.

Environmental Research Program Projects — 1990/91

The Environmental Research Program supported 142 research projects during the 1990/91 year in the six research areas. Some of these projects, while still active, received no financial contribution from the ministry in this period. A total of $2 847 813 was distributed through the program in the year.

During the year, 173 new proposals were received for consideration. Of these, 63 were recommended for funding by the Research Advisory Committee and approved by senior ministry management. A total of $3 445 500 was committed. These projects have only recently been initiated. A further five projects have been approved for funding since March 31, 1991

Projects designated with an asterisk were funded by profits from the Cleansweep lottery under the Water Related Research category (refer to Page 101).

Projects in Progress During 1990/91

Air Quality

001 An Intrinsic Chemically Selective Lipid-Based Wave Guide Organic Vapour Sensor

U.J. Krull

Department of Chemistry
Erindale College, University of Toronto
Mississauga, ON
L5L 1C6

ER 300G

Preparation and study of a novel integral optical sensor consisting of a chemically selective fluorescent lipid biomembrane. This system could be either portable or remote, and be able to provide sensitive long term detection of organic species of environmental significance. This technology could be used for the broad screening of organic vapours, mobile monitoring and selective chemical analysis of certain species such as PAHs.

Initiated: 1.87 Final Report Due: 1.91
Total Award: $34 500

002 Scale Model Studies and Development of Prediction Procedures for Heavy Gas Dispersion in Complex Terrain

RWDI Consulting Engineers
P.A. Irwin

650 Woodlawn Rd. W.
Guelph, ON
N1K 1B8

ER 310C

An existing simple box model was used in conjunction with a modified entrainment model of Picknett to predict downwind cloud concentration in the presence of obstacles. This appears to perform satisfactorily for the prediction of heavy gas dispersion in terrain in the far field. On a local scale, i.e. near to a building or barrier, physical modelling must be used to accurately predict the gas cloud behaviour.

Initiated: 7.87 Final Report Received
Total Award: $242 000

003 Modelling the Photochemical Decomposition of Chlorinated Phenols by Sunlight

N.J. Bunce

Department of Chemistry and Biochemistry
University of Guelph
Guelph, ON
N1G 2W1

ER 312G

Determination of the extent and speed of chlorophenol degradation in the atmosphere. Decomposition by solar photolysis is inversely related to chlorine content. With complementary alternative degradative processes in the atmosphere, it is suggested that most chlorophenol congeners will have similar atmospheric half-lives. Residence times for most chlorophenols of only one to two days in the troposphere are predicted under mid-summer conditions. This means that chlorophenols likely undergo substantial transformation prior to deposition.

Initiated: 5.87 Final Report Due: 5.90
Total Award: $21 152

004 Physical and Chemical Processes Affecting Long Range Transport of Air Pollution and Acid Rain

H.R. Cho

Department of Physics
University of Toronto
Toronto, ON
M5S 1A7

ER 313G

Study of some basic problems in chemical, physical and dynamic processes important to the modelling of long-range pollutant transport and acid rain. Using the Eulerian Model approach, this project has contributed to a greater understanding of pollutant transport and transformation during cyclonic storms in the north eastern United States.

Initiated: 4.87 Final Report Due: 12.90
Total Award: $291 540

005 Atmospheric Trace Gas Measurement Using a Tunable Diode Laser Absorption Spectrometer

D.R. Hastie

Department of Chemistry
York University
4700 Keele St.
North York, ON
M3J 1P3

ER 314G

Measurements of hydrogen peroxide, formaldehyde, ozone and nitrogen oxide precursors have been made at the ministry site at Dorset, Ont. Combining this information with meteorological records and existing ministry data on pollutants such as ozone, particulates and other groups of hydrocarbons gives a comprehensive chemical climatology of the site. It is now possible to categorize a number of ozone events as being either transport or locally photochemically dominated.

Initiated: 4.87 Final Report Due: 6.91
Total Award: $611 500

006 Determination of Source-Receptor Links by Size-Specific Multielemental Inorganic Component Determination and Modelling

R.E. Jervis

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, ON
M5S 1A4

ER 347G

Trace analysis of inorganic compounds in air samples to permit source profiles to be established and receptor modelling to be performed. Through the analysis of 40-45 inorganic constituents in size-fractionated collections, it has proved possible to clearly distinguish 5-8 pollutant sources in the Toronto, Hamilton and Sault-Ste. Marie airsheds. The neutron and proton activation methodology used for this analysis has proven superior to other methods such as atomic absorption spectrometry for this purpose.

Initiated: 10.87 Final Report Due: 9.91
Total Award: $93 400

007 Response of Sugar Maple Seedlings (Acer saccharum) to Aluminum Stress as Measured by Acid Phosphatase Activity, Rhizosphere pH (Al Avoidance) and Root Organic Acid Content (Al Detoxification)

M. Havas

Environmental And Resource Studies
Trent University
Peterborough
K9J 7B8

ER 350G

Elucidation of the mechanisms of aluminum toxicity and detoxification in sugar maple and three coniferous species. Considerable variations in species and ecotype sensitivity to Al have been determined with red spruce (*Picea rubens*) appearing the most susceptible. Populations of some species varied in their ability to "detoxify" Al suggesting considerable ecotypic variation. Sugar maple was not nearly as Al-sensitive as originally anticipated due to its ability to exude chelating citric acid into the rhizosphere.

Initiated: 2.88 Final Report Due: 12.92
Total Award: $96 860

008 Relationship of Sugar Maple and Corresponding Chemical Changes in Sap Composition (Carbohydrates and Trace Elements)

D.N. Roy

Department of Forestry
University of Toronto
Toronto, ON
M5S 1A4

ER 352G

Assessment of changes in sap composition which might correlate with the degree of decline in sugar maple trees. It has been demonstrated that total sugar content, pH, and levels of Ca, K, and B are lower in declined trees while Al, Mn, and Fe are higher. These chemical changes may be able to be correlated with a physical criterion such as the ministry decline index, or be used as an early indicator of this syndrome.

Initiated: 11.87 Final Report Due: 6.92
Total Award: $53 750

009 Digital Image Analysis of Particles In A Turbulent Wind

J.F. Keffer

Department of Mechanical Engineering
University of Toronto
Toronto, ON
M5S 1A4

ER 372G

Development of a database and predictive model for the trajectory of noxious particles such as lead. This information will permit a determination to be made of the amount of material uplifted initially at a given source. Local concentrations of fugitive emissions could then be predicted with acceptable accuracy via existing dispersion models. This increased understanding of the wind-erosion process would enable practical measures for controlling emissions from open sites to be identified and implemented.

Initiated: 6.87 Final Report Due: 6.90
Total Award: $140 184

010 Sampling Biomedical Waste Incinerators

Clayton Environmental Consultants
S. Viswanathan

400 Huron Church Rd.
Windsor, ON
N9C 2J9

ER 388C

Sampling from stacks of ten biomedical waste incinerators is being performed to characterize the content of emissions from such sources. Samples are being taken and analyzed for a) particulates, trace metals and hydrogen chloride, b) trace organic species such as PCBs, c) volatile organic species including chloroform and benzene, and d) bacteria, spores and viruses. Ash residue from each batch incineration is also further assayed for composition and used in a leachate study.

Initiated: 2.89 Final Report Due: 9.91
Total Award: $400 000

011 Modelling Higher Moments In the Concentrations Probability Distribution (Concentration Fluctuations)

Concord Scientific Corporation
E. Alp

2 Tippet Rd.
Toronto, ON
M3H 2V2

ER 389C

A mathematical modelling system to predict the magnitude and frequency of peak concentrations of aerial pollutants has been developed and implemented. This system combines dispersion and meteorological parameters to estimate pollutant concentration intensity and plume intermittency. Full-scale field evaluation has identified the wind conditions under which the model system should only be operated.

Initiated: 5.89 Final Report Due: 6.91
Total Award: $70 000

012 An Integral Model Study of the Airborne Chemical Contaminants from Chemical Plants and Research Buildings: Their Detection, Effects on Biological Systems, and Proposed Method for Their Elimination

M.C. Depew

Department of Chemistry
Queen's University
Kingston, ON
K7L 3N6

ER 400G

The technique of microwave induced catalysis has been developed and its effectiveness in the destruction of SO_2 and NO in effluent gas streams demonstrated. This methodology is based on the selectivity and efficiency of microwave interaction of these compounds and a ferromagnetic catalytic surface. This technology also appears to have application in the decomposition of halogenated hydrocarbons without the formation of complex, possibly toxic, aromatic byproducts.

Initiated: 4.88 Final Report Due: 1.91
Total Award: $104 000

013 Atmospheric Measurement of Natural Hydrocarbons Using Gas Chromatography/Mass Spectrometry

H. Niki

Department of Chemistry
York University
4700 Keele St.
North York, ON
M3J 1P3

ER 401G

Use of gas chromatography/mass spectrometry to measure a number of key volatile organic species such as biogenic hydrocarbons in air samples from forested areas. This forms part of the Eulerian Model Evaluation Study. Data is being used for comparison against model predictions and to gain a better understanding of atmospheric chemistry in a Canadian setting. Associated with this is the critical evaluation and improvement of sample collection and handling techniques for these labile compounds.

Initiated: 4.88 Final Report Received
Total Award: $256 458

014 Determination of Dose-Response for Tissue Contamination, and Growth of Vegetable Crops, Exposed to Chronic Levels of Organic Environmental Contaminants Originating from Industrial Processes

B.A. Marie

Department of Horticultural Science
University of Guelph
Guelph, ON
N1G 2W1

ER 405G

Development of three dimensional dose-response models for the bioaccumulation and growth response of root, leaf and fruit vegetables to foliar and root exposure to compounds such as naphthalene. Soil cation exchange characteristics, rather than contaminant concentration, appear to be the significant factor in determining the degree of plant injury when pollutants are present in the growing medium. These models for industrial organic compounds will complement those widely available for organic agricultural compounds.

Initiated: 4.88 Final Report Due: 8.92
Total Award: $108 151

015 Investigation of Vibration Isolation Method in a House for Reduction of Train Vibrations

J.H. Rainer

Institute for Research in Construction
National Research Council
Ottawa, ON
K1A 0R6

ER 407C

Train induced ground vibrations in residential structures were characterized and the effectiveness of elastomeric pads for their attenuation determined. Although there was some indication of a amplitude dependence on train type, speed and weight, site conditions, including surface profiles and soil composition, greatly overshadowed these variables. The placement of elastomeric pads between the ground and superstructure was not wholly successful in eliminating vibration conduction to the building.

Initiated: 4.88 Final Report Due: 1.91
Total Award: $73 419

016 Development of Multivariate Analysis Procedures for Ontario Air Quality Data

P.K. Hopke

Department of Chemistry
Clarkson University
Potsdam, NY
13699-5630

ER 433G

Development and testing of advanced multivariate statistical analysis methods. The objective is to enable the extraction of the maximum amount of useful information from the large data sets generated from ongoing ministry air quality monitoring programs. This will aid the development and implementation of air quality management plans to maintain or improve the air quality in Ontario.

Initiated: 5.89 Final Report Due: 3.93
Total Award: $59 200 U.S.

017 Testing Atmospheric Dispersion Model Performance and Developing Codes to Include Deposition into the Model

Atomic Energy of Canada Ltd.
E. Robertson

Chalk River Nuclear Laboratories
Chalk River, ON
K0J 1J0

ER 451C

Validation of the ministry regulatory model 308 using monitoring data from the Sudbury area. This is being coupled with the development of submodels to include depositional processes for sulphates and heavy metals. Apart from increased confidence in its application, the improved model will enable the better prediction of the loading of vegetated and aquatic surfaces by atmospheric pollutants from local sources. The effect of decreasing emissions can also be assessed.

Initiated: 5.89 Final Report Due: 11.91
Total Award: $22 000

018 An Assessment of Landuse Impact on the Microclimate of the Fonthill Kame

T.B. Shaw

Department of Geography
Brock University
St. Catharines, ON
L2S 3A1

ER 457G

Assessment of the possible modification by topographic change, such as through aggregate extraction, of the microclimate of the Fonthill Kame. This locale is the most important tender fruit growing area above the Niagara escarpment. Emphasis is being placed on a detailed analysis of the Kame's microclimate in terms of its spatial variations in nocturnal temperature and windspeed. Particular focus is on the depth and rate of cold-air drainage on a variety of slopes under radiation frost conditions.

Initiated: 6.89 Final Report Due: 2.92
Total Award: $30 500

019 A study of the Peak Ozone Levels in the Toronto Area

The MEP Company
L. Shenfeld

Suite 100, 7050 Woodbine Ave.
Markham, ON
L3R 4G8

ER 474C

Regression equations to accurately forecast peak ozone levels based on the long-range transport (LRT) of ozone and its precursors were developed and validated. These have proven to be reliable predictors of peak ozone levels in Toronto. By comparing the values derived from LRT with non-LRT regression equations, it has been shown that LRT from the industrial United States may increase peak ozone levels in Toronto by up to 49% under suitable meteorological conditions.

Initiated: 6.90 Final Report Received
Total Award: $11 925

020 The Development of a Long Range Transport with a Nested Fine Resolution Grid

The MEP Company
M. Niewiadomski

Suite 100, 7050 Woodbine Ave.
Markham, ON
L3R 4G8

ER 475C

Combining of the mesoscale simulation of atmospheric processes in GESIMA with the Eulerian long-range transport Acid Deposition and Oxidant Model (ADOM). This will produce a nested fine resolution grid of an area of southern Ontario. The resulting model will incorporate the ADOM input meteorology and emission inventory for eastern North America with the fine resolution input and output of GESIMA. This would provide the capability to simulate the transport, chemical transformations and deposition of atmospheric pollutants on a refined scale.

Initiated: 6.90 Final Report Due: 12.91
Total Award: $75 860

021 Phytotoxicity of Uranium

Atomic Energy of Canada Ltd.
S.C. Shephard

Whiteshell Laboratories
Pinawa, MB
R0E 1L0

ER 476C

Determination of the uranium concentration in soil that is toxic to plant growth. Inherent in this is the analysis of how toxicity varies with differences in soil properties and among plant species, and the documentation of symptoms of plant exposure to high levels of uranium. Observations on seed germination indicate little or no effect of concentrations below 300 mg U/kg soil, levels which greatly exceed those generally found in most areas contaminated by industry.

Initiated: 4.90 Final Report Due: 3.92
Total Award: $29 723

022 Interpretation of Sugar Maple (Acer saccharum) Ring Chronologies from Central and Southern Ontario Using a Mixed Linear Model

O.B. Allen

Department of Mathematics and Statistics
University of Guelph
Guelph, ON
N1G 2W1

ER 478G

Development of a model relating growth rate of sugar maples to climate and other factors. This growth rate data was previously collected from over 1000 trees in three Ontario regions exposed to varying levels of atmospheric pollution. Once the influence of these non-pollutant factors is removed, it can be determined whether enhanced pollution levels have been a factor in the reduced growth rate of sugar maple in southern and central Ontario over the past 50 years.

Initiated: 5.90 Final Report Due: 11.91
Total Award: $8 717

023 Dense Gas Dispersion Modelling Including Obstacles and Topography

EnviroTech Research Ltd.
S.R. Ramsay

1386 Hastings Dr.
London, ON
N5X 1B1

ER 479C

Development of analytical and numerical models to describe the effects of topography on dense gas dispersion. This is being achieved through an extensive review of relevant existing theoretical, experimental and field data. In conjunction with project ER 528C, this study is leading to the development of a dense gas dispersion model suitable for operation in the presence of difficult topography and obstacles such as buildings, and applicable to operational emergency management.

Initiated: 6.90 Final Report Due: 6.92
Total Award: $41 612

024 Basic and Applied Studies with a Trace Atmospheric Gas Analyzer

R.E. March

Department of Chemistry
Trent University
Peterborough, ON
K9J 7B8

ER 480G

Collaborative study with the ministry of the use of a Sciex Trace Atmospheric Gas Analyzer (TAGA 3000). With the equipment now installed and operational at the university, analytical protocols for the detection of compounds such as formaldehyde are being optimized along with research into gaseous ion/molecule reactions. This will ultimately facilitate the extended utilization of this major analytical technique.

Initiated: 5.90 Final Report Due: 11.93
Total Award: $153 150

025 Determination of Residential Wood Combustion Impact on Ontario Communities

Concord Scientific Corporation
M.E. Yandle

2 Tippet Rd.
Downsview, ON
M3H 2V2

ER 481C

Assessment of the environmental and health impact of residential woodburning combustion (RWC) through an ambient air monitoring program, and characterization of emissions from locally available wood stoves and fuels. Although RWC has been cited as a significant factor impacting on air quality, the magnitude of this is largely undocumented. This study will allow an evaluation of the necessity of mitigative practices and provide a background for any future legislative activity.

Initiated: 4.91 Final Report Due: 12.92
Total Award: $130 325

026 Analysis of Spatial and Temporal Distribution of Inhaleable Air Particulates in Ontario

R. Martin

Department of Chemistry
University of Western Ontario
1151 Richmond St.
London, ON
N6A 3K7

ER 482G

Study of inhaleable air particulates across the province. The objective is to establish their elemental composition, chemical state and reactivity, physical characteristics, and spatial and temporal distribution. Using various analytical techniques such as scanning electron microscopy and X-ray fluorescence, it appears that the combination of catalytic activity, surface chemistry and bulk analysis provides site specific data on spatial distribution. This information could be used to design an inhaleable particulate standard for Ontario.

Initiated: 5.90 Final Report Due: 9.93
Total Award: $117 100

027 The Significance of Metabolic Changes in Jack Pine Seedlings for Early Diagnosis of Fluoride Injury

J. Zwiazek

Department of Forest Science
University of Alberta
Edmonton, AB
T6G 2E1

ER 483G

Investigation of the effects of gaseous hydrogen fluoride on starch accumulation and membrane lipid composition in jack pine seedlings. Membrane leakiness has been shown to occur in plants after only 1 day of exposure to 2 ppb fluoride. Plasma membranes isolated from fluoride-treated plants show a number of alterations in chemical composition including changes in sterol content and ATPase activity. These metabolic changes may be suitable as diagnostic tools for the early detection of fluoride injury.

Initiated: 4.90 Final Report Due: 5.92
Total Award: $59 539

028 Development of a Video Image-Based Maple Decline Index

D. King

Department of Civil Engineering
Ryerson Polytechnical Institute
350 Victoria St.
Toronto, ON
M5B 2K3

ER 518G

Refinement and evaluation of a video image-based index utilizing both spectral and textural image characteristics for use in the assessment of sugar maple decline. The accuracy of this quantitative remote sensing technique is being evaluated on a tree by tree basis. Previously, it was successfully applied on a plot

by plot basis. Successful development of this methodology would provide a cost-effective alternative to ground-based techniques.

Initiated: 1.91 Final Report Due: 7.92
Total Award: $25 000

Water Quality

029 Trace Organic Contaminant Removal From Drinking Water

MacLaren Plansearch
J.R. Hilton

33 Yonge St.
Toronto, ON
M5E 1E7

ER 99C

An attempt to assess the effectiveness of both conventional and granulated activated carbon adsorption methods for the removal of selected trace organic compounds from drinking water. If successful, optimum process operational parameters for both systems will be investigated using both bench-scale and pilot plant evaluations of the two technologies.

Initiated: 4.84 Final Report Due: 12.91
Total Award: $940 900

030 Study of Some Factors Contributing to the Abundance and Persistence of Green Filamentous Algal Mats in Acidic Lakes

P. Welbourn (Stokes)

Institute for Environmental Studies
University of Toronto
Toronto, ON
M5S 1A4

ER 282G

Definition of potential causes for the development of filamentous green algal mats in acidifying lakes. An association between the presence of large grazers such as crayfish and absence of conspicuous algal accumulation was established suggesting a possible cause/effect relationship. This hypothesis was not, however, supported by direct observation of grazing habit. It has been subsequently proposed that it is grazing pressure on the attached benthic community, from where the filaments of the mat forming community possibly develop, that regulates the development of these algal mats.

Initiated: 9.86 Final Report Due: 11.90
Total Award: $89 836

031 Methods of Measurement and Speciation of Mercury in Natural Waters

P. Welbourn (Stokes)

Institute for Environmental Studies
University of Toronto
Toronto, ON
M5S 1A4

ER 286G

Assessment of new methods for extracting methylmercury from water and their use in evaluating a possible cause of increased mercury levels in sport fish. It was hypothesized that increased sulphate availability (such as would have arisen from acidic deposition) could contribute to elevated levels of methylmercury by stimulating the activity of sulphate-reducing (methylating) bacteria. It was determined, however, that the methylation rate of these bacteria was not sensitive to sulphate concentration over typical natural ranges.

Initiated: 10.86 Final Report Due: 6.90
Total Award: $149 369

032 Prediction of Rate of Oxygen Depletion in Recreational, Urbanized and Agricultural Lakes

Beak Consultants Ltd.
W.J. Snodgrass

14 Abacus Rd.
Brampton, ON
L6T 5B7

ER 294C

Development and application of a model relating the oxygen cycle to inputs of nutrients and dissolved organic carbon in lakes. The model relates potential oxygen demand and hypolimnetic oxygen depletion to the formation, decay and settling of particulate organic carbon, and to dissolved carbon. Through its capacity to evaluate components of sediment-water transport, it can provide information for estimating the release of pollutants such as metals from lake sediments.

Initiated: 11.86 Final Report Due: 4.91
Total Award: $64 300

033 Slow Sand Filtration for Production of Drinking Water in Small Northern Communities

Gore & Storrie Ltd.
W.J. Hargrave

1670 Bayview Ave.
Toronto, ON
M4G 3C2

ER 296C

Construction and demonstration of a slow sand filtration pilot plant for the treatment of drinking water. This treatment process would be particularly suitable for the water in areas such as northern Ontario with its inherent colour problems. The main advantage of this type of treatment is its simplicity. It therefore requires low capital and operating costs, little maintenance and few chemical inputs.

Initiated: 11.86 Final Report Due: 6.92
Total Award: $150 000

034 Quantitative Structure-Activity Relationships for Organic Compounds and their Mixtures

G.W. Ozburn

Department of Biology
Lakehead University
Thunder Bay, ON
P7B 5E1

ER 317G

Development of physiologically and environmentally realistic toxicity models which take into account the time course of accumulation. This is particularly important with toxicological effects of mixtures where net uptake may proceed at different rates for each chemical. A one-compartment first-order kinetics model of accumulation, combined with the critical body residue concept, has been shown to adequately explain the observed time-LC50 data for independently observed bioassays of mixtures of chlorobenzenes, chloroethanes and chloroethylenes.

Initiated: 4.87 Final Report Due: 11.90
Total Award: $134 932

035 An Examination of the Chronic Toxicity of Thiocyanate to Freshwater Fish for the Development of a Water Quality Criterion

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 320G

Assessment of the effects on fish of chronic sublethal exposure to thiocyanate. Sublethal thiocyanate toxicity appears to involve impaired thyroid function. This is suggested by histological evidence regarding goitre development, alterations in thyroid hormone levels in trout, deformities in cranial cartilage development, and suppression of secondary sexual characteristics and egg production in mature fathead minnows. Dramatic reduction in egg production in minnows appears to be the most sensitive indicator of thiocyanate toxicity.

Initiated: 4.87 Final Report Due: 4.91
Total Award: $111 700

036 The Effects of Agricultural Drainage on Sediment and Water Quality Loadings

D.W.E. Watt

Department of Civil Engineering
Queen's University
Kingston, ON
K7L 3N6

ER 321G

Development, calibration and verification of a model encompassing the pathways and fates of agricultural chemicals (fertilizers and pesticides) applied to tile-drained fields. Use of the TILE quality model for both real and synthetic rainfall events has demonstrated the relative importance of 1) pesticide application methods, 2) rainfall occurrences following application, and 3) soil characteristics on the transport of contaminants to the tile drains and ultimately to receiving waters.

Initiated: 4.87 Final Report Due: 1.91
Total Award: $90 000

037 In situ Determination of Faecal Indicator Bacteria Survival in Agriculturally Impacted Watersheds

M. Walters

Lake Simcoe Region Conservation Authority
P.O. Box 282
Newmarket, ON
L3Y 4X1

ER 344G

Estimation of *E. coli* and *P. aeruginosa* survival at six rural locations within the confines of the Lake Simcoe and Metro Toronto Region Conservation Authorities Rural Beaches Study areas. Bacterial die-off rates were determined to be considerably slower than those reported for urban rivers and streams. A seasonal effect was also noted with more rapid die-off occurring during the summer and spring. This bacterial survival information is necessary for input into pollution transport models.

Initiated: 8.87 Final Report Due: 9.91
Total Award: $164 500

038 Lake Water Quality Monitoring Based on Remotely Sensed Data: Phase II

J.R. Pitblado

Department of Geography
Laurentian University
Sudbury, ON
P3E 2C6

ER 354G

Characterization and classification of the lakes (in terms of general trophic state as well as discriminating between acidified and non-acidified) in three major areas on the Precambrian Shield using Landsat TM data. The derivation of associations between Landsat TM spectral reflectance data and water quality parameters will aid in the establishment of a remote sensing lake water quality monitoring program for Ontario.

Initiated: 10.87 Final Report Due: 6.91
Total Award: $123 000

039 Geochemical Characterization, Size Fractionation and Bio-Availability of Trace Metal-Particulate Associations in the Don River

A.P. Zimmerman

Department of Zoology
University of Toronto
Toronto, ON
M5S 1A1

Determination of the physical and chemical characteristics of suspended particulates and their association with heavy metals at four sites along the Don River. Of the four metals assayed, cadmium showed the most predictable pattern of binding being only associated with the most easily exchangeable iron and manganese oxide fractions. Copper and lead exhibited the most variable patterns of geochemical association. Metal levels in suspended sediments appear to exceed provincial guidelines for dredgeate material.

ER 355G

Initiated: 10.87 Continued as ER 493G
Total Award: $31 400

040 Development of a Hydrologic Model to Predict the Environmental Fate of De-Icing Salts

K.W.F. Howard

Physical Sciences Division
Scarborough Campus, University of Toronto
1265 Military Trail
Scarborough, ON
M1C 1A4

ER 356G

Performance of a catchment mass balance approach on the Highland Creek basin in Metropolitan Toronto. Records of salt application and estimates of chloride output from measurements of stream flow reveal that only 45% of the salt applied to the catchment is being removed annually. If present rates of salt application are maintained, average chloride concentrations in groundwaters underlying the basin and in stream baseflow will eventually exceed 400 mg/l. This represents a 3-fold increase over present average baseflow concentrations.

Initiated: 5.88 Final Report Due: 11.91
Total Award: $98 650

041 Development of an Optimum System for the Application and Regeneration of Powdered Activated Carbon in Water Treatment Plants

ZENON Environmental Inc.
A. Benedek

845 Harrington Ct.
Burlington, ON
L7N 3P3

ER 379C

A Powdered Activated Carbon/Cross Filtration system for potable water treatment was successfully demonstrated on a pilot scale. The system was shown to be particularly effective for the removal of turbidity,

bacteria and odour. It is also able to remove dissolved toxic organic pollutants. This technology is expected to be most economically competitive in the smaller treatment market where a simpler, cheaper system is more desirable. It could also be used as a mobile emergency treatment system.

Initiated: 1.88 Final Report Received
Total Award: $330 125

---

042 The Carbon and Sulphur Cycle in Shallow, Unconfined Aquifer Systems

R.W. Gillham

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 382G

Characterization of the fluxes and (bio)transformations of the carbon and sulphur pools in two aquifers by means of isotopic, geological and geochemical techniques. Synthesis and geochemical modelling of data is defining the role of organic carbon in groundwater sulphur and nitrogen redox processes. In contrast to man-made organic contaminants in the hydrosphere, very little is presently known of the role of naturally occurring dissolved organic compounds in groundwater.

Initiated: 10.87 Final Report Due: 1.91
Total Award: $68 335

---

043 The Origin and Distribution of Methane in the Alliston Aquifer

J.F. Barker

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2G 3L1

ER 383G

Identification of both the origin of methane in the Alliston sand aquifer and the geochemical and hydroecological factors controlling its distribution. The methane is formed by microbial processes (methanogenesis) and encouraged by the presence of organic rich sediments. Its distribution is apparently not controlled by the nature of the bedrock. This information will contribute to the establishment of a basis for prediction of methane occurrences in aquifers.

Initiated: 10.87 Final Report Due: 9.91
Total Award: $63 175

---

044 Proposal for Partial Support of a Collection of Algal, Microbial and Plant Cell Cultures

C. Nalewajko

Department of Botany
University of Toronto
Toronto, ON
M5S 3B2

ER 387G

A collection of 190 freshwater algae, cyanobacteria and selected bacteria isolates has been established primarily by consolidation of existing smaller collections. These were supplemented through the isolation of cultures from local environments, particularly those from acid-stressed lakes and metal- and organically-polluted sites. This collection is now available to both Canadian and foreign users such as universities, government and businesses. Prior to its establishment, no large source of cultures for environmental and biotechnological research existed in Canada.

Initiated: 1.88 Final Report Received
Total Award: $36 000

---

045 Fish Waste Production — Rainbow Trout Culture

P.S. Chisholm

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 394G

Development and evaluation of a model to estimate waste production from rainbow trout culture facilities relative to fish growth. This model incorporates fish growth in relation to temperature, corresponding intake of feed of known composition, related digestibility and excretion ratios. It could be used as a basis for estimating waste production from a fish culture operation taking into account fish growth stage and corresponding feed consumption.

Initiated: 4.88 Final Report Due: 11.90
Total Award: $22 950

046 Tillage and Event Based Soil and Phosphorus Loss

R.G. Kachanoski

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 396G

Examination of the spatial and temporal variations of soil and water loss under different tillage systems and soil types using a portable rainfall simulator. Infiltration and therefore runoff rate varied with rainfall intensity and the size of the experimental plot. This suggests that it may be difficult to define effective hydroecologic variables that will represent the behaviour of a heterogeneous hillside. Physical models based on effective (average) hillslope properties may therefore have limited predictive value.

Initiated: 6.88 Final Report Due: 2.92
Total Award: $202 500

047 Assessment of Faecal Pollution Transport in Agriculturally Impacted Watersheds Using a Biotracer

M. Walters

Lake Simcoe Region Conservation Authority
P.O. Box 282
Newmarket, ON
L3Y 4X1

ER 416G

Development and use of instream pollution tracing methodology using naladixic acid resistant *E. coli* for the determination of faecal pollution transport to beaches. These indicator bacteria have been established to die-off more rapidly under warmer temporal conditions. However, when nutrient levels are in positive correlation with water temperature or bacteria are associated with river bed sediments, this rate is slowed. Such information is directly applicable to attempts to model rural watersheds and establish pollution control measures.

Initiated: 5.88 Final Report Due: 11.89
Total Award: $60 370

048 Wildlife Toxicology Fund

World Wildlife Fund, Canada
Ms. Pegi Dover

Suite 201, 60 St. Clair Ave. E.
Toronto, ON
M4T 1N5

ER 417G

The mandate of the World Wildlife Fund is to provide high quality scientific information that can be directly applied to the protection of wildlife in Canada from toxic chemicals in the environment, to enhance and develop private sector expertise, and to act as a stimulus for the joint funding of research projects. In support of these objectives, ministry funds during the year were allocated for the support of two projects; "Metabolic Consequences of Environmental Acidification in Fish" and "The Influence of Lake Acidification on Reproductive Success of the Common Loon in Ontario".

Initiated: 6.88 Final Report Due: 1.92
Total Award: $150 000

049 Monitoring Exposure and Effects of Organic Substances in the Huron Erie Corridor

G.D. Haffner

Great Lakes Institute
University of Windsor
Windsor, ON
N9B 3P4

ER 424G

Development of a calibrated network of long-term biomonitoring stations for organic contaminants. Five sites have been set up along the Huron-Erie corridor to investigate temporal and spatial heterogeneity of contaminants in various media. Studies to date strongly indicate that food web dynamics play a major role in regulating species specific chemical exposure.

Initiated: 10.88 Final Report Due: 9.92
Total Award: $600 000

050 Carinogenicity Testing of Industrial Effluents Using a Rainbow Trout Assay

C.D. Metcalfe

Environmental and Resource Studies
Trent University
Peterborough, ON
K9J 7B8

ER 429G

Determination of the potential for bleached kraft mill

effluent (BKME) to be carcinogenic to fish through *in vivo* and *in vitro* assays. Some evidence indicates a capacity for compounds in BKME to induce a carcinogenic response. This may however, be through a secondary mechanism whereby the carcinogenic response to a potent hepatocarcinogen, aflatoxin B_1, is enhanced. Other sublethal toxicological endpoints have also been noted in trout exposed to BKME during the study.

Initiated: 5.89 Final Report Due: 2.93
Total Award: $128 730

---

051 Development of an Expert System for Decision Making with Regard to Water Quality in Ontario Rivers

T.E. Unny

Faculty of Engineering
University of Waterloo
Waterloo, ON
N2L 3G1

ER 431G

Further development of an expert system WATQUAS (Water Quality Assessment System). WATQUAS integrates experience-oriented human-based factual knowledge and information, both discrete and distributed, with quantifiable values extracted through data based models. This interactive computer based system could be used by engineers to provide comprehensive robust water quality assessment.

Initiated: 4.89 Final Report Due: 12.90
Total Award: $27 500

---

052 In situ Biodegradation of Chlorinated Solvents as a Remedial Technology for Contaminated Groundwater

Beak Consultants Ltd.
D. Major

595 Woolwich St.
Guelph, ON
N1H 3Y5

ER 441G

Determination of factors and processes governing the *in situ* transformation and degradation of tetrachloroethene in the groundwater at a contaminated chemical transfer facility. Field and laboratory experimentation has provided evidence that anaerobic biotransformation of this compound can occur with ethene probably being the final nonchlorinated product of the sequence. This attenuating mechanism might therefore be exploited in site remediation.

Initiated: 5.89 Final Report Due: 12.91
Total Award: $80 000

---

053 Ecology and Control of the Biofouler Dreissena polymorpha, (Bivalvia: Dreissanidae), New to the Great Lakes

G.L. Mackie

Department of Zoology
University of Guelph
Guelph, ON
N1G 2W1

ER 443G

Comprehensive study of the biology, ecology and distribution of zebra mussels in Lake St. Clair and the Great Lakes. Growth dynamics and lifecycle features of local zebra mussels are atypical of any recorded European population. This has implications regarding the suitability and timing of control measures. Adverse impacts have been observed on native unionid clams. Suffering under infestations of up to 3000 mussels on their exposed shell, the existence of the 14 native clam species in the Great Lakes appears threatened.

Initiated: 5.89 Final Report Due: 5.93
Total Award: $122 694* (partial)

---

054 Groundwater Impact from Large Septic Systems for Sewage Disposal in Ontario

J.A. Cherry

Waterloo Center for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 444G

Monitoring of groundwater in a shallow sand aquifer impacted by a large-flux system. Water quality immediately below the tile bed was similar to that of smaller systems in similar hydrologic settings. In contrast however, nitrate was attenuated in the downgradient plume core apparently as a result of anaerobic denitrification. The persistence of nitrate along the aerobic upper fringe of the plume however, demonstrates the potential ability of septic systems to cause significant water-quality degradation under favourable conditons.

Initiated: 5.89 Final Report Due: 11.92
Total Award: $195 000

055 Regional Low Flow Analysis for the Central and Southeastern Regions of Ontario

Cumming Cockburn Ltd.
H.S. Belore

Suite 203, 350 Oxford St. W.
London, ON
N6H 1T3

ER 445C

Evaluation of four methods for estimating low flow characteristics for unguaged watersheds in central and southeastern regions of Ontario. The technique of mapped isolines, generated using digital terrain modelling procedures, was determined to be the best method for this purpose. It provided more accurate predictions than more common methods such as regional regression equations and the area proration method. Accurate estimation of low flow statistics for unguaged watersheds is essential for analyzing water quality conditions and environmental impacts.

Initiated: 10.89 Final Report Due: 4.91
Total Award: $52 500

056 Verification Studies of a Bioconcentration-Based Model for Predicting Pulse-Exposure Toxicity of Organic Contaminants to Fish

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 447G

Testing of the capabilities of an existing model to predict the acute and sublethal toxicity of organic contaminants to fish across a wide range of pulse-exposure regimes. Water quality guidelines based on mean exposure concentration have been shown to be inconsistent in protecting aquatic life exposed to toxicant pulses. Validation of this model would assist in the ultimate development of a sound scientific basis for developing water quality guidelines.

Initiated: 5.89 Final Report Due: 11.90
Total Award: $40 164

057 Bias due to Sampling Groundwater and Surface Water for Trace Organic Contaminants

J.F. Barker

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 449G

Evaluation of two critical sources of bias when sampling waters for organic compounds and fixed gases such as methane: 1) volatilization, and 2) sorption of organic compounds onto well casing and/or sampling material. The latter is being evaluated using novel methodology that predicts sorption based on the hydrophobicity of the organic, the material and the contact time. Through this evaluation, improvements for volatile organic sampling in regulatory and research environments will result.

Initiated: 5.89 Final Report Due: 11.90
Total Award: $46 750

058 Standardized Rearing Materials and Procedures for Hexagenia, a Benthic Bioassay Organism

J. Ciborowski

Department of Biological Science
University of Windsor
Windsor, ON
N9B 3P4

ER 450G

Evaluation of the power of a serial dilution sediment bioassay procedure for *Hexagenia* larvae using sediment highly contaminated with organochlorine compounds. This method, through greater effective sample size and the use of size-blocked individuals (reducing variability), provides greater statistical power than current methods. Some of these require mean differences of over 50% to establish statistical significance. Development of standard rearing and test procedures would overcome the lack of comparability inherent with many current ecotoxilogical studies.

Initiated: 5.89 Final Report Due: 3.93
Total Award: $48 283

059 Multispectral Remote Sensing Techniques for Past, Present and Future Mapping of Chlorophyll

Moniteg Ltd.
A.R. Kalinauskas

630 Rivermede Rd.
Concord, ON
L4K 2H7

ER 452C

Simulation of water quality data from past, present and future satellites using the company's Fluorescence Line Imager (FLI). The FLI is a prototype system for satellites. FLI data was collected by airborne surveillance over a portion of the Lake of Woods, Ont. Further

processing of the dataset obtained with this high spectral resolution system has produced a new model for detection and mapping of inland lake surface chlorophyll concentration. This correlates extremely well with *in situ* water samples collected concurrently.

Initiated: 5.69 Final Report Due: 12.90
Total Award: $49 181

---

060 Retractable Absorbents for Environmental Clean-Up: Commercialization Program and Field Trials

Ecoplastics Ltd.
A.E. Redpath

518 Gordon Baker Rd.
Willowdale, ON
M2H 3B4

ER 456C

Evaluation of retractable absorbents for the removal of chlorinated solvents from water. Trials in the St. Clair River have confirmed laboratory studies as to the efficacy of this technique. Mats of crosslinked ethyl vinyl acetate placed on the river bottom proved to be successful in the absorption of small pools of tetrachloroethylene remaining from the major spill in 1985.

Initiated: 6.89 Final Report Due: 5.91
Total Award: $97 340

---

061 PCB Dynamics in Pottersburg Creek

N. Kaushik

Department of Environmental Biology
University of Guelph
Guelph, ON
N1G 2W1

ER 460G

With the exception of fish, concentrations of PCBs in biota have decreased temporally and spatially along Pottersburg Creek since remedial measures were enacted. Analyses of gut contents of fish indicated that chironomids and worms are important food sources and thus serve as important vectors in the transfer of PCBs. Biota are able to accumulate PCBs in short periods of time particularly when exposed to sediments and contaminated food. Depuration occurs more slowly.

Initiated: 10.89 Final Report Due: 7.92
Total Award: $27 000

---

062 Statistical Assessment of Multivariate Ordination Techniques for Zoobenthic Communities and Water Chemistry for Lakes from Central Ontario

H. Harvey

Department of Zoology
University of Toronto
Toronto, ON
M5S 1A1

ER 461G

Sampling of benthic invertebrates and water chemistry from 19 lakes in the Muskoka region to supplement an existing set of 20 lakes. A multivariate measure (PROTEST) testing the concordance between benthic invertebrates, water chemistry, lake morphometry and spatial arrangement has been developed. This will allow a statistically valid approach to the definition of the relationship of biotic and environmental variables, a possibility not afforded by current statistical methodology.

Initiated: 10.89 Final Report Due: 9.92
Total Award: $14 614

---

063 The Relative Effect of Individual Environmental Factors on Indicator Bacterial Survival

E. Harris

Lake Simcoe Region Conservation Authority
P.O. Box 282
Newmarket, ON
L3Y 4X1

ER 462G

Evaluation of the effects of water quality variables on faecal coliform bacterial survival in laboratory survival experiments. Survival response of *E. coli* and *P. aeruginosa* was heightened by elevated levels of dissolved organic carbon (DOC). This survival phenomenon was most pronounced at warmer temperatures (20°C), but was also evident at cooler conditions. Reducing inputs that cause increased DOC levels in streams may therefore help to increase bacterial die-off, and lessen the pollution impact on downstream areas.

Initiated: 11.89 Final Report Due: 5.91
Total Award: $46 000

064 Impact of Bleached Kraft Mill Effluent (BKME) on White Sucker Populations Near Terrace Bay, Ontario

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 463G

Examination of the impact of exposure to BKME on various growth, biochemical and reproductive characteristics of white sucker fish. Fish exposed to BKME were shorter, older and had decreased growth rates compared to reference sites. Females contained fewer eggs at maturation, males had reduced sexual characteristics. Both sexes showed an increased age to maturation. A trend from pollution sensitive species to that of pollution tolerant was also observed.

Initiated: 10.89 Final Report Received
Total Award: $38 640

065 An Investigation of the Potential of Zygnemataceae zygospores as Paleo-Indicators of Recent Lake Acidification

P. Welbourn (Stokes)

Institute for Environmental Studies
University of Toronto
Toronto, ON
M5S 1A4

ER 464G

Increased growth of zygnematacean algae in lakes during the early stages of lake acidification suggested their possibility as paleoindicators of early acidification. Based on observations from 11 study lakes however, zygnematacean zygospores were not practical paleo-indicators of lake acidification. This was primarily due to their dilution by pollen from the surrounding forests. However, it was concurrently determined that fossil cysts of *Peridinum spp.* and coenobia of the green algae *Pediastrum* may hold promise due to their abundance and strong response to acidity and alkalinity.

Initiated: 10.89 Final Report Received
Total Award: $35 454

066 CO_2 Production and Carbon Cycling in Precambrian Shield Watersheds

S. Schiff

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 465G

Evaluation of carbon fluxes between the main carbon pools, atmospheric and soil CO_2, and dissolved inorganic and organic carbon of two forested watersheds located in the Precambrian Shield. Soil CO_2, groundwater, streams and lake water are being sampled using isotopic and chemical methods to determine spatial and temporal variations of these pools. This will aid in the better understanding of the effects of anthropogenic influences such as acidification and climate change on these ecosystems.

Initiated: 10.89 Final Report Due: 9.92
Total Award: $66 240

067 Zooplankton Communities and Water Chemistry of Sudbury Lakes: Changes Related to pH Recovery

W.G. Sprules

Department of Zoology
University of Toronto
Toronto, ON
M5S 1A1

ER 468G

Survey of zooplankton communities in 92 Sudbury area lakes. Changes in community species and structure are being considered in relation to the increased water pH (1.6 units) that has occurred in these lakes since a similar study was conducted in 1971-73. Number and diversity of zooplankton species have previously been shown to depend on pH with acidic conditions negatively affecting both these characteristics. The recovery in pH of these lakes should be reflected in the plankton communities.

Initiated: 6.90 Final Report Due: 1.92
Total Award: $24 100

068 Abiotic Factors Involved in Predicting Trace Metal Levels in Freshwater Bivalves

A. Tessier

INRS — Eau
Universite du Quebec, Ste Foy
C.P. 7500
Ste-Foy, PQ
G1V 4C7

ER 469G

Identification of the mechanisms underlying metal uptake by clams based on the geochemical and biological processes involved. Together with samples of porewater, overlying water and sediments, freshwater bivalves, *Elliptio complanata* and *Anodonta grandis*, have been collected along spatial geochemical gradients for analysis. Results are being used to develop models capable of predicting metal accumulation. This methodology is a promising alternative to empirical approaches which have proven disappointing in their predictive ability.

Initiated: 6.90 Final Report Due: 1.92
Total Award: $22 056

069 Sequential Sampling, Amphibod Abundance, and Lake Acidification: Development of a Simple and Ubiquitous Biomonitoring Tool

W.D.N.R.G. Limnetics
R.L. France

417 Haney St.
Winnipeg, MB
R3R 0Y5

ER 470G

A sequential sampling program based on the littoral amphipod *Hyalella azteca* for the ubiquitous, cost-effective biomonitoring of the effects of lake acidification was developed. The sensitivity of *Hyalella* to low pH has been demonstrated to make it a suitable biological indicator for this purpose. This design of methodology able to be applied consistently to any situation will ensure comparability of data among sites and/or times.

Initiated: 9.89 Final Report Received
Total Award: $5 200

070 Assessment of Environmental Genotoxin Sediment Contamination in the Niagara River Watershed

M. Dickman

Department of Biological Sciences
Brock University
St. Catharines, ON
L2S 3A1

ER 472G

Assessment of sediment concentration and chironomid body burden of non-volatile chlorinated hydrocarbons such as PAHs. Sampling before and after the clean up of PAH coal tar contaminated sediments in the Kane Dock area of the Niagara River indicated that the proportion of deformed chironomids had declined from 18% to 7%. This is well within normal background levels as determined at an upstream "control" site. PAH contaminated sediments are therefore clearly implicated in the inducing of chironomid deformities.

Initiated: 11.89 Final Report Due: 5.91
Total Award: $23 100

071 Verification Studies of a Body Burden Based Model for Predicting the Sublethal Toxicity of Fluctuating Contaminant Exposures to Fish

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 486G

Examination of a body residue model for assessing the effects of fluctuating toxicant exposure on small fish. Whole body toxicant residues were found to be a good surrogate of dose and predictive of the effects on fathead minnows of time variable exposures to chlorinated organic compounds. Development of this scientific basis to ecosystem health assessment will have application in the formation of water quality guidelines which are sensitive to pulse and fluctuating toxicant exposures.

Initiated: 5.90 Final Report Due: 10.91
Total Award: $28 444

072 Removal of Chlorophenols from Wastewaters by the Photolysis of Hydrogen Peroxide Using Ultraviolet Light and Sun-Simulated Light

J. Bolton

Department of Chemistry
University of Western Ontario
1151 Richmond St.
London, ON
N6A 3K7

ER 487G

Examination of the feasibility of H_2O_2 photolysis for the removal of organic pollutants from waste water streams. Photodegradation mechanisms and rates, as affected by structural chemistry, are being determined by flash photolysis followed by rapid high performance liquid chromatography analysis. H_2O_2 is a readily available industrial chemical and has no known adverse effects on the environment. A practical system based on this process would be an attractive alternative technology for chlorophenol destruction.

Initiated: 5.90 Final Report Due: 11.91
Total Award: $42 500

073 Development of Reliable Treatment Systems for Milkhouse Wash Water

P.H. Groenevelt

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 489G

Elimination of the problem of improper disposal of milkhouse wash water through development of more reliable treatment systems. Research has shown that weeping bed disposal systems could be made to last three to five times longer if farmers were to flush residual milk from the pipeline before commencing washing procedure. Reducing the amount of water used in the washing procedure also improves reliability. This latter practice also reduces hydro consumption and cleaning chemical use.

Initiated: 5.90 Final Report Due: 12.92
Total Award: $46 000

074 Evaluation of the Impact of Timber Management Practices on Lake Water using Satellite Remote Sensing Data

GEOSCAN Ltd.
H. George

189 Victoria St.
Kingston, ON
K7L 3Y9

ER 490C

Digital analysis of lake images derived from satellite remote sensing is being performed to map the concentration of inorganic suspended sediments in relation to nearby logging activities. With the establishment of this relationship between timber management practice and water quality, the methodology could be used in routine operational surveillance as a means of alerting authorities of the need for detailed ground investigation.

Initiated: 7.90 Final Report Due: 6.92
Total Award: $32 943

075 The Efectiveness of a Stormwater Management Pond in the Removal of Urban Contaminants from Stormwater

D.W.E. Watt

Department of Civil Engineering
Queen's University
Kingston, ON
K7L 3N6

ER 491G

Monitoring of an on-line stormwater management control pond in Kingston Township. The objective is to characterize the pond's ability to remove water borne contaminants from the stormwater. An instrument system and control structures for monitoring rainfall, pond level, inflow and outflow have been installed, and field sampling begun. Through development and use of a model based on water quality and quantity data, the contaminant removal function in future on-line ponds could be enhanced.

Initiated: 4.90 Final Report Due: 10.93
Total Award: $89 600

076 Causes of Pollution-Associated Neoplasms in Fish in Lake Ontario

M.A. Hayes

Department of Pathology
University of Guelph
Guelph, ON
N1G 2W1

ER 492G

Determination of the causative factors involved in pollution associated liver cancers in benthic fish in western Lake Ontario. White sucker fish have been found to possess a very efficient mechanism for the detoxification of PAH metabolites. Common parasitic liver diseases, however, interfere with this process. This suggests that white suckers and other benthic fish are remarkably resistant to PAH metabolites, and that the presence of naturally occurring parasitic liver diseases indirectly contributes to neoplasm formation.

Initiated: 6.90 Final Report Due: 10.92
Total Award: $110 810

077 Geochemical Characterization and Size Fractionation of Metal/Particulate Discharges to the Don River

A.P. Zimmerman

Department of Zoology
University of Toronto
Toronto, ON
M5S 1A1

ER 493G

Evaluation of trace metal transport by suspended sediments in the Don River. This is being achieved through the assessment of the trace metal/suspended sediment associations of three outfall types (sewage treatment plant, "residential" and "industrial"). By examining specific types of discharge sources, the relative importance of these sources for *in situ* river patterns of trace metals/suspended sediment associations can be determined. Prioritization of source abatements and the effectiveness of proposed remedial action plans can then be objectively evaluated.

Initiated: 11.90 Final Report Due: 6.92
Total Award: $19 060

078 Impact of Bleached Kraft Mill Effluent on Reproductive, Biochemical and Immunological Characteristics of White Sucker and Whitefish

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 494G

Assessment of the effectiveness of a secondary treatment aeration lagoon at a paper mill for reducing the environmental impact of Bleached Kraft Mill Extract (BKME). The location of the study was Jackfish Bay, Lake Superior, where a system had recently been installed. No change in the magnitude of indicator characteristics such as hepatic mixed function oxygenase activity were detected in fish sampled relative to that prior to instalment. This suggests that one year of secondary treatment has not been successful in eliminating the chronic reproductive impacts of BKME.

Initiated: 4.90 Final Report Received
Total Award: $44 108

079 Flow of Manure Through Soil Macropores

R. Fleming

Agricultural Engineering Section
Centralia College of Agricultural Technology
Huron Park, ON
N0M 1Y0

ER 495G

Determination of the importance of soil macropores and tillage practice in the flow of liquid manure through two soil types. Macropore size is dependent on soil type being larger in a sandy loam soil compared with a clay loam. Based on work with soil columns taken from farm fields, neither soil type or tillage system (no-till or conventional tillage) seems to significantly alter the quantity of effluent moving through the soil.

Initiated: 5.90 Final Report Due: 11.91
Total Award: $53 100

080 The Use of Environmental Isotope Surveys in Assessing Contamination Potential for "Confined" Aquifers

M. Sklash

Department of Geology
University of Windsor
Windsor, ON
N9B 3P4

ER 500G

Demonstration of the usefulness of regional environmental isotope studies in assessing the contamination potential of confined aquifers. The Essex County aquifer is being used as a case study for this purpose. Through the analysis of hydrometric, isotopic and geochemical data, the source of recharge water (and therefore the potential pathway for contaminant introduction) into this aquifer is being determined. This has relevance to both point and non-point sources of groundwater contamination in this region and in similar hydrogeological environments.

Initiated: 5.90 Final Report Due: 10.92
Total Award: $50 972

081 Determination of Geochemical Modification of Groundwater Entering Surface Waters from an Industrial and a Municipal Disposal Site

D.R. Lee

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 510G

Investigation of the conditions under which contaminant flux from sediments to surface water may be controlled by reactions within the biogeochemical transition zone at this interface. Data, obtained through field monitoring and laboratory experimentation, can be used for testing subsurface/surface water transport models. This study will contribute to the development of a strong scientific basis for the regulation of groundwater-contaminant loading of surface water.

Initiated: 5.90 Final Report Due: 11.92
Total Award: $36 215

082 Development and Validation of a New, Rapid and Economical Surrogate Bioassay for Industrial Contaminants

BOREALIS Environmental Consulting Inc.
G.L. Gilron

1728 - 156 A St.
White Rock, BC
V4A 4W1

ER 511C

Establishment of toxicological dose-response relationships for industrial waste discharges using a novel 15 minute chemotactic bioassay technique based on the ciliated prototist *Tetrahymena vorax*. To date, four of 11 effluents tested with this protocol yielded results comparable with standard bioassays using *Daphnia magna* and rainbow trout. Future work is aimed at improving this sensitivity. Successful development of this microbial assay would address the need for a more inexpensive, simple and rapid test for toxicant mixtures.

Initiated: 6.90 Final Report Due: 3.92
Total Award: $47 915

083 The Impact of Farm Liquid Waste Application on Receiving Water

D. Dean

Ausable-Bayfield Conservation Authority
P.O. Box 240
Exeter, ON
N0M 1S0

ER 512G

Indicator faecal bacteria and various chemical parameters in tile drain water were measured after 12 manure spreading events. Without flow in the tile drain at the time of application, or with soil tillage prior to it, contamination did not occur. Consideration of the specific field conditions prior to manure application could therefore be used to reduce the possibility of water contamination from this practice.

Initiated: 5.90 Final Report Received
Total Award: $77 000

084 Solid Waste Management Land Based Rainbow Trout Culture

P.S. Chisholm

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 516G

Monitoring and modelling of the characteristics of non-filterable solid wastes produced by rainbow trout over the growth range 10 to 300 grams. This solid waste is produced in land based trout culture in the form of uneaten and undigested fish feed. This information will be applied to the development of design guidelines for sedimentation tanks required at different stages of fish growth.

Initiated: 12.90 Final Report Due: 6.93
Total Award: $28 800

085 To Develop a Reliable, Economical and Environmentally Safe Method of Milkhouse Effluent Disposal Using Pretreatment and/or Modified Leaching Bed Methods

C. Weil

Engineering Section
Alfred College of Agriculture and Food Technology
P.O. Box 580
Alfred, ON
K0B 1A0

ER 519G

Evaluation of a sequential batch generator and two types of leaching bed systems for the treatment of milkhouse effluent. Pilot treatment plants have been installed at the college and on a local dairy farm for this purpose. Results of this program could potentially benefit thousands of dairy farmers in Ontario. It would aid in the remediation of waterways impacted on by agricultural activity, a concern raised by the Rural Beaches Program.

Initiated: 11.90 Final Report Due: 7.94
Total Award: $121 000

086 Development of Hepatic Micronucleus Assay in Fish

C.D. Metcalfe

Department of Biology
Trent University
Peterborough, ON
K9J 7B8

ER 521G

Development of an *in vivo* hepatic micronucleus assay with rainbow trout to test for the genotoxic effects of aquatic contaminants such as diethylnitrosamine. The liver is the tissue most frequently developing neoplasms. This assay protocol has been tested with a number of toxic compounds and these shown to produce a positive response. This technique has potential to be used as an indicator of exposure to point-source discharges of genotoxic compounds.

Initiated: 12.90 Final Report Due: 6.93
Total Award: $30 000

Liquid and Solid Waste

087 An Extraction and Concentration Method for the Testing of Landfill Leachates, Soil Fractions and Liquid Industrial Wastes for Genotoxic Organic Compounds

ORTECH International
D. Rokosh

2395 Speakman Dr.
Mississauga, ON
L5K 1B3

ER 103C

Advances have been made in concentration methods for low levels of organics in water. Specifically, two concentration methodologies, employing either accumulator resin columns or cryogenic trapping of purgeable volatile compounds, have been significantly improved. Of equal importance, the groundwork has been laid for the designing of such concentration methods, including hardware devices for use with relatively insensitive biological tests.

Initiated: 6.84 Final Report Received
Total Award: $300 000

088 Establishing Vegetation on Erosion-Prone Landfill Slopes in Ontario

Gartner-Lee Associates Ltd.
T.W. Hilditch

Suite 102, 140 Renfrew Dr.
Markham, ON
L3R 8B6

ER 307C

Guidelines for the establishment of vegetation on landfill slopes in Ontario were derived from a study of 24 landfill sites across the province. Primary limiting factors to consider when planning a program of revegetation for erosion control include slope steepness, soil compaction, soil chemistry and appropriateness of species selected for seeding. A manual describing site/problem characterization procedures and planting program considerations when planning a complete landfill revegetation strategy is now available.

Initiated: 5.87 Final Report Received
Total Award: $193 000

089 The Mobility and Persistence of Selected Organic Solutes in Anaerobic Groundwater and Possible in situ Remediation

J.F. Barker

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 330G

Determination of the fate and persistence of aromatic hydrocarbons and chlorinated organics under anaerobic conditions. In general, anaerobic conditions did not prove uniformally successful for *in situ* remediation purposes. However, field experiments indicated considerable potential for remediation of certain compounds under specific conditions. This list includes toluene and relatively oxidized chlorinated hydrocarbons such as carbon tetrachloride and hexachloroethane. In contrast, compounds such as benzene and chlorobenzene appear to be sufficiently recalcitrant to preclude anaerobic *in situ* bioremediation.

Initiated: 4.87 Final Report Due: 11.90
Total Award: $378 900

090 Slow Rate Infiltration Land Treatment and Recirculation of Landfill Leachate in Ontario

R.A. McBride

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 333G

Evaluation of the effects on forest and grassland terrestrial ecosystems on slow rate infiltration of landfill leachate. Recommendations as to site conditions and operational practices were suggested including 1) recipient soils should have moderate clay content, 2) leachate should be applied by a surface or sub-surface system to avoid direct foliar contact, 3) the preferred species to be established on the irrigated area are those tolerant of highly variable soil moisture and nutrient regimes, or with high water requirements.

Initiated: 4.87 Final Report Due: 2.93
Total Award: $472 400

091 Behaviour, Detection and Control of Hazardous Immiscible Liquid Movement in Soil

G.J. Farquhar

Department of Civil Engineering
University of Waterloo
Waterloo, ON
N2L 3G1

ER 334G

Examination of the movement of immiscible liquids such as chlorinated solvents, and their vapours, in soil. Immiscible liquids are highly mobile moving as a separate phase in both water and air-water systems. Although considered immiscible, these compounds are still sufficiently soluble to bring about widespread levels of dissolved contamination. Modelling their movement in soil will be a significant contribution towards the capability to gauge the potential for groundwater contamination under specific conditions.

Initiated: 4.87 Final Report Due: 10.90
Total Award: $174 700

092 Development of the Backfill and Construction Application Guidelines

Canviro Consultants Ltd.
G.Zukvos

Suite 302, 2233 Argentia Rd.
Mississauga, ON
L5N 2X7

ER 336C

Establishment of the usefulness of industrial waste material such as fly ash and blast furnace slag in specific construction or backfill applications. This has primarily involved detailed bulk quality characterization and leachate testing of material from selected sites, as well as site hydrogeologic investigations. This will assist in the development of guidelines that would facilitate the environmentally safe and beneficial use of solid industrial waste as backfill materials.

Initiated: 7.87 Final Report Due: 6.90
Total Award: $195 000

093 Development and Demonstration of Permanent On-Site Solutions for Hazardous Waste Site Rehabilitation and Restoration at an Organic Chemical Plant

Canviro Consultants Ltd.
R.J. Rush

Suite 600, 180 King St. S.
Waterloo, ON
N2J 1P8

ER 368G

Through a review of state-of-the-art and "emerging" technologies for organic contaminant behaviour modelling and treatment, selected technologies are being developed and demonstrated on a field scale. This is being done at the Uniroyal Chemical manufacturing site in Elmira, Ont., a location that typifies organic contamination problems at waste disposal and industrial sites.

Initiated: 10.87 Final Report Due: 3.92
Total Award: $401 590

094 A Study of Geochemical Modification of Groundwater Discharging into Surface Waters from an Industrial Disposal Site

R. Lee

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 392G

Determination of the changes in major ion chemistry during groundwater discharge (modified by slag dump leachate) at a major offshore discharge area. Using a weighted probe containing temperature and electrical processors, it is possible to quantify the geochemical changes that occur during the final metres of groundwater flow into surface waters. Without consideration of this geochemical interface, it is not possible to predict solute fluxes from zones of onshore groundwater to contiguous surface waters.

Initiated: 4.88 Final Report Due: 12.90
Total Award: $29 050

095 Measuring Groundwater Velocity and Hydrodynamic Dispersion in a Single Fracture in Fractured Shale

J.A. Cherry

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 393G

Development of a model based on the hydromechanical interaction between fracture asperities as a determinant of closure and distribution of fracture apertures in rock. For rocks with low matrix permeability, these fractures are a dominant pathway for the subsurface migration of contaminants. Quantification of fracture aperture is required to estimate groundwater velocity. This measure is essential in determining the potential for contaminant transport from waste and industrial sites.

Initiated: 6.88 Final Report Due: 2.92
Total Award: $120 000

096 Recycling of Textile Dyebath Effluent

A. Wilcock

Department of Consumer Studies
University of Guelph
Guelph, ON
N1G 2W1

ER 421G

Evaluation of the efficacy of three electrochemical cells (iron, aluminum, and an iron/aluminum hybrid) for colour removal from dyebath effluent. Evaluation of simulated effluents from commonly used disperse dyebaths in the laboratory showed that toxicity could be reduced by electrochemical treatment. Treated dyebaths could be successfully reused to produce first-

quality dyeings. However, actual industrial effluent was not decolorized to the extent predicted by the laboratory model. This suggests that some interfering substance may have been released from fabric.

Initiated: 6.88 Final Report Due: 6.92
Total Award: $55 000

---

097 Field Demonstration of Membrane Technology for Treatment of Landfill Leachate

ZENON Environmental Inc.
R.P. Canning

845 Harrington Ct.
Burlington, ON
L7N 3P3

ER 439C

Technical and economic assessment of a membrane based reverse osmosis process for the treatment of landfill leachate. A field testing program demonstrated overall process removals for key contaminants of concern from low strength leachate to be generally over 90%, at waste volume reductions of 75-80%. Comparison of the costs of this process indicated that a treatment process incorporating conventional precipitation/clarification and reverse osmosis can provide a cost effective alternative to biological treatment at some sites.

Initiated: 4.89 Final Report Due: 10.91
Total Award: $130 000

---

098 Quantifying Infiltration Through Municipal Solid Waste Landfill Covers

Ecologistics Ltd.
K.J. Mc Kague

Suite A1, 490 Dutton Dr.
Waterloo, ON
N2L 6H7

ER 440C

Measurement of the portion of infiltration water which passes through a landfill cap through installation of lysimeters at two landfills. Apart from establishing the reliability of lysimeters for this application, the accuracy of the mathematical Hydrologic Evaluation of Landfill Performance (HELP) model is made possible. Accurate data on rates of infiltration as affected by various factors is important as excess water can accumulate in the landfill, leach wastes into groundwater and enhance landfill subsidence.

Initiated: 4.89 Final Report Received
Total Award: $121 990

---

099 Determination of Hydroecological and Contamination Transport Properties of Fractured, Weathered Leda Clay in Eastern Ontario

Fondex Ltd.
G. Felio

Suite 2, 30 Concourse Gate
Nepean, ON
K2E 7V7

ER 466C

Definition of the depth of fractures and quantification of the fracture flow within the Leda clay zone. Areas having different thicknesses and depositional environments are being considered. Otherwise naturally "impervious", the uppermost part of this clay deposit is weathered and fractured. With the possibility of burial of municipal or industrial waste in this area, characterization of these features is essential. The presence of an active hydrogeological fracture network could provide a lateral and vertical pathway for contaminant migration.

Initiated: 10.89 Final Report Due: 6.92
Total Award: $79 159

---

100 Nonaqueous Phase Liquid Removal from Soil and Rock

G.J. Farquhar

Department of Civil Engineering
University of Waterloo
Waterloo, ON
N2L 3G1

ER 477G

Determination of the rates of dissolution of chlorinated solvents from soil pores into groundwater. Monitoring of trichloroethylene (TCE) dissolution from sand packed glass columns revealed that after an initial period of rapid dissolution and high effluent concentrations, a phase of slow and protracted release of residual TCE occurred. This greatly extended the period of unacceptable effluent concentration. This has implications for the duration of treatment required in pump and treat remediation.

Initiated: 5.90 Final Report Due: 12.92
Total Award: $160 000

101 Retention of Toxic Landfill Leachate Metals by Soil

L.J. Evans

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 484G

Assessment of the influence of pH and chloride on heavy metal retention by soils. In contrast to lead and zinc, cadmium and particularly mercury cations were readily removed from soil in the presence of chloride. This effect is due to the strong affinity of these two metals with this anion relative to the charged surfaces of soil and sediment particles. This observation has implications for the retention of these metals in landfill systems under conditions of high salt loadings.

Initiated: 5.90 Final Report Due: 3.93
Total Award: $78 050

102 Ontario Hydrobiotite-Vermiculite as a Potential Landfill Liner Adsorbent

Curtis & Associates Ltd.
L.W. Curtis

Unit 9, 3105 Unity Dr.
Mississauga, ON
L5L 4L2

ER 485C

Characterization of the mineralogy and properties of a deposit of mixed layer clays and vermiculite occurring near Perth, Ont. The ability of the material to retain heavy metals exceeds its cation exchange capacity suggesting alternative retention mechanisms such as precipitation are acting. Specific surface areas of the soils are moderately high and selected compacted soils returned low permeability results. Given these and other characteristics, the deposit may constitute a viable source of material for specialized landfill liner or adsorbent applications.

Initiated: 6.90 Final Report Received
Total Award: $47 735

103 Experimental and Theoretical Study of Guelph Pilot Scale Solid Waste Composter

L. Otten

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 501G

Monitoring of the City of Guelph's pilot hybrid aerated pile/in vessel composting system. Determination of temperature and moisture content profiles in the reactor, inbound waste composition and compost quality are necessary to obtain accurate information on reactor performance. This data can also be used in the development of a control system, the design of full scale composting plants and the development of a computer model to describe and simulate the composting system.

Initiated: 4.90 Final Report Due: 3.93
Total Award: $90 540

104 Bioconversion of the Mechnically Separable Paper Fraction of Municipal Solid Waste to Fuel Alcohol

M. Wayman

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, ON
M5S 1A4

ER 502G

Development and optimization of an enzymatic process for the bioconversion of the mechanically separable paper fraction of municipal solid waste to ethanol, a potential fuel additive. This could reduce the amount of municipal refuse by 50%. Enzymatic liquefaction of waste paper and fermentation of the resulting sugars has given ethanol yields of 350-400 litres per tonne of paper, equivalent to 200 litres per tonne of refuse. This represents a nearly 50% improvement over currently available acid hydrolysis processes.

Initiated: 5.90 Final Report Due: 10.92
Total Award: $96 000

105 Physical Modelling of Contaminant Plumes from Landfills

R.J. Mitchell

Department of Civil Engineering
Queen's University
Kingston, ON
K7L 3N6

ER 505G

Application of centrifuge techniques for the modelling of contaminant transport in the partly saturated soil zone beneath a clay liner. Dimensional analysis of the factors controlling contaminant transport in porous media has shown that gravitational modelling is necessary when performing physical modelling of transport in partly saturated soils. Centrifuge modelling has the added advantage of accelerating flow and transport phenomenon so that several years of real life contaminant migration can be observed within days.

Initiated: 5.90 Final Report Due: 10.93
Total Award: $50 500

106 Accurate Control Testing for Clay Liner Permeability

R.J. Mitchell

Department of Civil Engineering
Queen's University
Kingston, ON
K7L 3N6

ER 506C

The use of small diameter (0.5m) centrifuges for laboratory and field testing of clay permeability was successfully demonstrated. Centrifuge testing of clay liners was found to be free of both the technical difficulties and leakage risks normally associated with laboratory permeability tests of fine grained soils. This methodology facilitates rapid evaluation of the hydraulic properties of clay liners. It also permits realistic stress modelling for performance evaluation with regard to such aspects as leachate compatibility and compaction conditions.

Initiated: 6.90 Final Report Received
Total Award: $12 600

107 An Experimental Research Study on Methods of Revegetating the Kam-Kota Tailings Site

K. Winterhalder

Department of Biology
Laurentian University
Ramsey Lake Rd.
Sudbury, ON
P3E 2C6

ER 515G

Assessment of revegetation as an alternative to expensive mechanical/technical solutions for the closing out of the Kam-Kota tailings site. Closure of this mill left 275 hectares of sulphide-rich acid-generating tailings. Use of a loam, peat or gravel covering coupled with the incorporation of neutralizing agents such as dolomitic limestone successfully counteracted the upward movement of acidic ground water. Successful transplanting of metal-tolerant ecotypes of native species such as dwarf birch has also proven possible.

Initiated: 8.90 Final Report Due: 2.92
Total Award: $12 000

108 Solid Waste Stabilization in a Landfill Environment

D.W. Kirk

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, ON
M5S 1A4

ER 517G

Determination of the stabilization mechanisms and fate of solid wastes within a landfill environment. Simulated landfill test cells, some containing hazardous waste, had previously been maintained to the stage of landfill stabilization. Through extensive chemical, physical and morphological analysis, changes in the nature of landfill material in this period are being assessed. Knowledge of stabilization processes is critical to the design of landfill barriers and liners because of the long term consequences of containment failure.

Initiated: 12.90 Final Report Due: 6.93
Total Award: $78 071

Analytical Methods and Instrument Development

109 Studies of Methodology for Rapid Evaluation of Leaching from Municipal Wastes

F.W. Karasek

Department of Chemistry
University of Waterloo
Waterloo, ON
N2L 3G1

ER 406G

Development of a standard procedure for the evaluation of leaching of organic compounds from municipal wastes. The method consists of simple elution of fly ash packed in a stainless steel column. After an on-line partitioning step for organics and class fractionation by HPLC, subsequent analysis of compounds is possible by gas chromatography/mass spectrometry. This method is reproducible and can be adapted (e.g. by altering eluent pH) to closely simulate naturally occurring processes.

Initiated: 5.88 Final Report Due: 2.90
Total Award: $46 000

110 Flow Injection Sample Introduction for Inductively Coupled Plasma Atomic Emission and Mass Spectrometry

E.D. Salin

Department of Chemistry
McGill University
845 rue Sherbrooke ouest
Montreal, PQ
H3A 2T5

ER 414G

Successful optimization of the parameters of a continuous flow system, Flow Injection Analysis, and its interfacing with a discrete sampling system, Direct Sample Insertion, for the analysis of trace metals by atomic emission and mass spectrometry. Overall detection limit improvements in the order of 1000 fold have been realized. This technology is already operational in ministry laboratories. It allows the detection of most elements of toxic or industrial significance at levels near natural background concentrations.

Initiated: 4.88 Final Report Due: 3.92
Total Award: $132 500

111 Adaption of Water Preconcentration Techniques Developed for PCDD Analysis to Other Target Organic Pollutants

B.R. Hollebone

Department of Chemistry
Carleton University
Ottawa, ON
K1S 5B6

ER 420G

Application of the automatic preconcentration sampler (APS) for the preconcentration of organic compounds such as polyaromatic hydrocarbons and organochlorines. The APS incorporates both filtration and adsorption technology. Based on the use of an *in situ* Soxhlet apparatus for extraction, moderately volatile compounds do not appear to be recovered well due to evaporative losses. Interferences in both the columns and particularly the filters have been observed making it difficult to define any distribution pattern for particular compounds.

Initiated: 5.88 Final Report Due: 12.90
Total Award: $186 000

112 Development of an Expert System for Automated Analysis of Metals

M.J. Stillman

Department of Chemistry
University of Western Ontario
1151 Richmond St.
London, ON
N6A 3K7

ER 432G

Design and implementation of ACexpert, an expert system that controls access to a number of other expert advisory systems for the analytical chemistry laboratory. Examples of these include ACselect which advises on analytical method selection based on sample analysis information, and AAexpert which deals with the analysis of metals by atomic absorption spectrometry. Implementation of expert system technology is seen as an essential next step in improving productivity and analytical capability when dealing with complex environmental samples.

Initiated: 4.89 Final Report Due: 2.93
Total Award: $151 360

113 Investigations into the Analysis of Hydride-Forming Elements

I.D. Brindle

Department of Chemistry
Brock University
St. Catharines, ON
L2S 3A1

ER 434G

Development of methodology for the simultaneous analysis of hydride-forming elements such as arsenic, tin, and germanium with detection limits of the order of 10-100ppt. Although the hydride generation technique is relatively simple and highly sensitive, it suffers from interferences due to certain metal ions in the sample solution. L-cystine and L-cysteine have been determined to be highly effective agents for the pre-reducing process and the reduction of these interferences thereby increasing sensitivity.

Initiated: 5.89 Final Report Due: 11.90
Total Award: $135 900

114 New Chemical and Ecotoxicological Test Methods for Determining Toxic PCDD, PCDF and PCB Cogeners in Fish, Sediments and Other Aquatic Media

T.O. Tiernan

Department of Chemistry
Wright State University
3640 Colonel Glenn Highway
Dayton, OH
43435

ER 442G

A multi-dimensional computer model has been developed which can be applied to the identification of optimum stationary phase coatings for bonded-phase capillary gas chromatography columns. Optimum separations of selected mixtures of organic compounds would then be possible. The model incorporates parameters such as the temperature program, column length and functional group interactions. This approach was successful in predicting the separations of the entire set of the 2,3,7,8-chlorine substituted PCDD and PCDF isomers.

Initiated: 5.89 Final Report Due: 10.91
Total Award: $107 134

115 Solid Supported Reactions: The Chemical Basis for Development of Automation

J.M. Rosenfeld

Department of Pathology
McMaster University
1200 Main St. W.
Hamilton, ON
L8N 3Z5

ER 446G

Further development and optimization of solid supported reaction techniques for the direct extraction and purification of herbicides and chlorophenols from water. Focus is being placed on the use of higher temperatures and increased volumes as a means of improving sensitivity and specificity. Particular attention is being placed on overcoming interferences generated from background fatty acids. These may be present both in the original sample, or introduced during sample preparation through contaminated laboratory equipment.

Initiated: 5.89 Final Report Due: 12.90
Total Award: $40 000

116 New Methods for Rapid Sample Digestion

E.D. Salin

Department of Chemistry
McGill University
845 rue Sherbrooke ouest
Montreal, PQ
H3A 2T5

ER 453G

Development of an interrupted flow microwave-assisted wet digestion system for vegetation, biological and geological samples. In this system, a sample plug is pumped into a coiled tube which serves both as a container and digestion vessel. The sample flow is stopped, the coil is sealed by turning off the input and output valves and microwave power is applied (typically for 2 minutes) for sample digestion. This methodology provides an attractive alternative to conventional microwave-assisted digestion which requires labour intensive sample preparation.

Initiated: 6.89 Final Report Due: 4.92
Total Award: $40 000

117 Standard Reference Materials for Trace Organic Analysis of Aqueous Environmental Samples

ZENON Environmental Inc.
J.A. Coburn

845 Harrington Ct.
Burlington, ON
L7N 3P3

ER 454C

Development of standard reference aqueous solutions of highly hydrophobic materials using generator columns. These solutions could be used to calibrate analytical methods and to produce spiked samples for the checking of sample stability during field sampling, transportation and storage. It has proven possible to prepare columns with the organic compounds hexachlorobenzene, hexachlorobenzene and aldrin, and endosulfan I. Additional development is required prior to the application of this technology to extremely hydrophobic compounds such as chlorinated dibenzo(p)dioxins.

Initiated: 6.89 Final Report Due: 9.91
Total Award: $44 000

118 Practical Application of Faecal Coliform to Streptococcus faecium subsp. casselliflavus (SC) and Bifidobacterium to SC ratios to determine human and animal sources of pollution

P.L. Seyfried

Department of Microbiology
University of Toronto
Toronto, ON
M5S 1A8

ER 467G

Isolation of SC, *Bifidobacterium* (B), *Escherichia coli* (EC), and faecal coliforms (FC) from faeces and various water sources. This data is being used to compare the applicability of FC:SC, EC:SC, and B:SC ratios for the determination of human and/or animal sources of pollution. Human faecal specimens have FC:SC and B:SC ratios greater than 1.0×10^6:1 whereas animals produce ratio values closer to 10:1. On this basis, the majority of waters sampled to date suggest animal rather than human sources of pollution.

Initiated: 10.89 Final Report Due: 1.92
Total Award: $27 500

119 Automatable Total Cyanide Analysis

D.W. Kirk

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, ON
M5S 1A4

ER 497G

Development of a continuous automatic analytical technique for the routine analysis of total cyanide. The methodology is based on selective UV irradiation dissociating aqueous metal cyanide complexes to simple cyanide, thereby allowing a single cyanide value determination to be made. This method would be an attractive alternative to the standard acid distillation method for the determination of total cyanide. It suffers from a number of matrix interferences and is too time consuming and labour intensive to be used on a routine basis.

Initiated: 5.90 Final Report Due: 10.91
Total Award: $29 500

120 Development of an Automated Batch Hydride Generator for the Determination of Arsenic and Selenium

I.D. Brindle

Department of Chemistry
Brock University
St. Catharines, ON
L2S 3A1

ER 498G

Automation of the batch hydride generator for the determination of several hydride forming elements. By replacing all of the manual functions by a computer controlled system, the uncertainties of operator error are effectively removed. This overcomes the lack of reproducibility previously inherent with this method. The technique now available is relatively insensitive to matrix elements, provides enhanced signals, and can be used for the simultaneous quantification of several hydride forming elements.

Initiated: 5.90 Final Report Due: 10.91
Total Award: $40 000

121 Isolation of Pesticides and their Residues from Groundwater and Well Materials with Supercritical Fluid Extraction

J.B. Pawliszyn

Department of Chemistry
University of Waterloo
Waterloo, ON
N2L 3G1

ER 499G

Development of an alternative sample preparation method for the determination of trace organic contaminants in water. This involves the replacement of the Soxhlet leaching of the adsorbent material with supercritical fluid extraction. This could eliminate the need for a large amount of organic solvents and significantly shorten the sample preparation step. With most adsorbents considered, all PCBs could be extracted quantitatively with pure carbon dioxide. Most PAHs however, require use of methanol or toluene as a modifier.

Initiated: 5.90 Final Report Due: 12.92
Total Award: $30 000

122 Development of an Enzyme Immunoassay for the Rapid Detection and Quantification of Glyphosate

Paracel Laboratories Ltd.
C. Morin

Suite 100, 2319 St. Laurent Blvd.
Ottawa, ON
K1G 4K6

ER 503C

Molecular modelling has been performed to optimize the structure of a glyphosate-carrier protein immunogen, the first step in the development of an immunoassay for this herbicide. Optimization of this configuration is necessary so as to expose the glyphosate's characteristic features to the fullest extent. Analysis of glyphosate in environmental samples is usually achieved using multi-step extraction procedures and expensive HPLC instrumentation. Development of an enzyme immunoassay procedure for screening samples prior to analysis would therefore be very desirable.

Initiated: 8.90 Final Report Due: 12.92
Total Award: $79 900

123 Development of Techniques and Methodologies for the Direct Analysis of Solids and Difficult Samples by ICP-AES and ICP-MS

E.D. Salin

Department of Chemistry
McGill University
845 rue Sherbrooke ouest
Montreal, PQ
H3A 2T5

ER 504G

Evaluation and comparison of two sample introduction methods for the direct analysis of solids by ICP-AES and ICP-MS. The Direct Sample Insertion (DSI) technique places the sample directly in the plasma while the Electrochemical Vaporization (ETV) system heats the sample remotely before conducting the vaporized analyte to the plasma. The detection limits for Pb, Cd, and Zn obtained by ETV for Pb, Cd and Zn in solid samples were 0.6, 1 and 3ppb respectively. The DSI has successfully determined major, minor, and trace metals in geological materials.

Initiated: 5.90 Final Report Due: 10.93
Total Award: $117 000

124 Development of Procedure for Improved Data Quality for Monitoring Sewage Treatment Plants under the MISA Program

Canadian Association for Environmental Analytical Laboratories
P. Sly

Suite 404C, 1 Nicholas St.
Ottawa, ON
K1N 7B7

ER 514G

Establishment of a certification and accreditation process to evaluate the performance level of private Ontario analytical laboratories. With an inventory of Ontario laboratories capable of working on sample materials from Sewage Treatment Plants (STP) complete, work is now focussing on developing generalized criteria for the accreditation process. An interlaboratory comparison study using materials designed to simulate a range of STP samples is also underway.

Initiated: 8.90 Final Report Due: 2.93
Total Award: $213 000

Environmental Socio-Economics

125 To Evaluate Beach Use Benefits Related to Water Quality Improvements

Ecologistics Ltd.
M. Fortin

Suite A1, 490 Sutton Dr.
Waterloo, ON
N2L 6H7

ER 374C

Development of an evaluation procedure to estimate changes in beach use levels and to forecast potential benefits of proposed beach water quality rehabilitation measures. This would provide a base of empirical information on beach use behaviour and beach user benefits with particular application in amenity valuation.

Initiated: 10.87 Final Report Due: 2.92
Total Award: $79 100

126 Environmental Valuation Research

J.L. Knetsch

Department of Economics
Simon Fraser University
Burnaby, BC
V5A 1S6

ER 418G

Investigation of assessment and policy implications of the recent findings of large disparities between willingness-to-pay and compensation-demanded measures of economic value. This could form the basis for the improvement of economic valuation theory. Findings suggest that the assumptions on which most current assessments are based often lead to inappropriate policy choices. Situations in which this likely occur include remedies for harm, the setting of pollution standards, formulation of economic incentive schemes and waste treatment/disposal site selection.

Initiated: 5.88 Final Report Due: 6.92
Total Award: $75 400

127 Behaviour Ecology of the Eastern Subterranean Termite in Ontario as a Basis for Control

K. Grace

Faculty of Forestry
University of Toronto
Toronto, ON
M5S 1A4

ER 427G

Comprehensive characterization of the population dynamics and ecology of this termite. Biological findings have been used to improve aggregation trap design and efficiencies for use in control systems. In these, trapped termites are treated in ways which induce delayed mortality and transmit slow-acting toxicants or vector microbial agents back into the colony. Short wave UV treatment, borate compounds acting as slow acting transmissible stomach poison, and several fungi, viruses and nematodes have shown promise.

Initiated: 3.89 Final Report Due: 2.93
Total Award: $194 760

128 Modelling Municipal Water Systems for Demand Management

J. Robinson

Department of Environment and Resource Studies
University of Waterloo
Waterloo, ON
N2L 3G1

ER 437G

Development of a computer model of the municipal water system that incorporates demand management options. With demand management, the need for expansion of water supplies and waste water treatment plants could be delayed. Based on the water system of the Regional Municipality of Waterloo, the model includes an interactive user interface as opposed to a spreadsheet approach. To date, modelling efforts have focussed on the effect of price on demand, and a consideration of water saving fixtures.

Initiated: 5.89 Final Report Due: 7.92
Total Award: $52 658

129 Psychosocial Impacts in Populations Exposed to Solid Waste Facilities

S. Martin Taylor

Department of Geography
McMaster University
1280 Main St. W.
Hamilton, ON
L8S 4L8

ER 473G

Study of the psychosocial effects on populations exposed to environmental contamination. Psychosocial effects are defined as the complex of distress, dysfunction and disability manifested in a range of psychological and social responses to actual or perceived exposure to contamination. This particular study involves an epidemiologic survey of residents living within a prescribed radius of three waste facilities. A supplementary study is being conducted on the Hagersville tire fire situation.

Initiated: 3.90 Final Report Due: 9.92
Total Award: $206 605

130 Reassessment of the Efficiency of Market Policies for Pollution Control

D.N. Dewees

Department of Economics
University of Toronto
Toronto, ON
M5S 1A1

ER 507G

Re-evaluation of the merits of economic policies for pollution control recognizing the benefits of emission reductions below the target level where appropriate. The basis of this reassessment is the observation that in many situations, environmental benefits are proportional to pollution reductions. Reducing ambient concentrations below a target may therefore be just as valuable as achieving the target itself. Most evaluations of economic policies give no credit for environmental quality improvement beyond a fixed target.

Initiated: 5.90 Final Report Due: 9.92
Total Award: $13 920

131 Municipal Recycling Programs and Household Conservation Behaviour

R. Kreutzwiser

Department of Geography
University of Guelph
Guelph, ON
N1G 2W1

ER 508G

Respondents in 161 households in Guelph, Ont. involved in different pilot recycling programs (Blue Box and Wet Dry) were interviewed regarding their conservation behaviour and attitudes. Environmentally responsible consumer behaviour was greater among Wet Dry respondents. However, no differences in energy and water conservation behaviour and water management attitudes between the groups was found. Consequently, this study found only limited support for the hypothesis that participation in municipal recycling programs fosters other forms of household conservation behaviour.

Initiated: 5.90 Final Report Due: 10.91
Total Award: $6 165

132 Economy-Environment Linkages and Sustainable Development in Ontario

VHB Research and Consulting inc.
P.A. Victor

509 - 720 Spadina Ave
Toronto, ON
M5S 2T9

ER 509C

An input-output model for the provincial economy including resource utilization and the generation of wastes has been developed. This framework can be used to provide a means of quantifying economy-environment linkages in Ontario and assist in the examination of sustainability of development through scenario analysis. This model also has possibilities for use in many areas of policy analysis, such as examining the impacts of climate change on the Ontario economy.

Initiated: 7.90 Final Report Due: 5.92
Total Award: $216 900

Multimedia Contaminants and Biotechnology

133 Hamilton Air: Chemical Composition and Genotoxic Activity of Respirable Particulate and Organic Vapours

D.W. Bryant

Department of Biochemistry
McMaster University
1200 Main St. W.
Hamilton, ON
L8N 3Z5

ER 386G

Biological and chemical characterization using a bacterial assay system of respirable particulates and organic vapours in Hamilton air. Emphasis is being placed on PAHs and PAH derivatives. Elevated levels of nitro-PAH detected by this assay in air samples implicate NO and NO_2 as important factors in the genotoxicity of urban air particulates.

Initiated: 2.88 Final Report Due: 11.91
Total Award: $370 396

134 Mutagenicity Studies and Risk Estimation of Complex Mixtures of Organic Airborne Contaminants

D.M. Logan

Department of Biology
York University
4700 Keele St.
North York, ON
M3J 1P3

ER 390G

Development of a mathematical model for the prediction of mutagenic effects of complex mixtures of airborne pollutants. This has proven achievable. Risk due to individual chemicals can be assessed and their pairwise interactions in an animal test system can be quantitatively measured. From this, interaction constants can be derived. These can then be used in the same way as multi-enzyme systems are examined to accurately predict the net effect of several mutagens in mixtures of different proportions.

Initiated: 2.88 Final Report Due: 10.90
Total Award: $195 000

135 Chemical Exposure Pathways in Ontario

D. Mackay

Institute for Environmental Studies
University of Toronto
Toronto, ON
M5S 1A4

ER 423G

Development of mathematical models which can describe, and ultimately predict, the fate of chemicals in regions such as Ontario. Estimated concentrations in exposure media are combined with average rates of human contact or consumption of the media to yield estimates of chemical exposure. Critical to this process is the establishment of 1) the relationship between chemical concentrations in air and soil and those in plant tissues, and 2) the nature of bioaccumulation in the aquatic food chain.

Initiated: 8.88 Final Report Due: 3.92
Total Award: $136 500

136 Avian Pest Dispersal Mechanisms for Horticultural Crops

F. Ingratta

Horticultural Research Institute of Ontario
Vineland Station, ON
L0R 2E0

ER 445C

Review of existing world literature pertaining to the prevention and control of bird predation and/or interference. Emphasis is placed on bird control systems for sweet cherries, blueberries and grape crops. The review includes acoustic, non-acoustic and biological methods and addresses the problem of using acoustic devices in mixed urban-agricultural areas. Resulting from this will be recommendations for effective bird control management systems that comply with existing environmental regulations.

Initiated: 6.89 Final Report Due: 12.90
Total Award: $14 500

137 Survey of Community Acceptance of Air Conditioner Noise

HRAI Technical Services Division Inc.
W.J. Heeley

Suite 322, 5468 Dundas St. W.
Islington, ON
M9B 6E3

ER 458G

Establishment of a relationship between air conditioner noise levels and subjective responses of neighbours. This information could be of possible use in formation of noise regulations. Subjective and objective data were obtained for 550 subjects in the Metro Toronto Region. Despite difficulties associated with air conditioner noise levels being not much greater than background noise levels, adverse responses were significantly related to objective noise measures. This was particularly so for the signal/noise ratios rather than the measured noise levels.

Initiated: 6.89 Final Report Due: 12.90
Total Award: $10 000

138 Review of Established Regulatory Policies Using Genotoxicity Tests, Current Capability and Recommendations for Future Developments

Cantox Inc.
E.R. Nestmann

Suite 200, 627 Lyons Lane
Oakville, ON
L6J 5Z7

ER 459C

Review of existing and anticipated test capabilities of the ministry, compared and contrasted to regulatory agencies internationally. This report will provide a forum for discussion, and through its suggested guidelines and recommendations, assist the ministry in its genotoxicity policy development.

Initiated: 1.90 Final Report Due: 9.91
Total Award: $59 675

139 Characterization and Biotechnical Uses of the Extracellular Emulsifying Agent Produced by Pseudomonas aeruginosa

H. Lee

Department of Environmental Biology
University of Guelph
Guelph, ON
N1G 2W1

ER 496G

Purification, production, and evaluation of the extracellular oil emulsifier produced by *Pseudomonas aeruginosa* UG2 for the *in situ* emulsification and subsequent biodegradation of hydrocarbons. Such a surfactant could be used to enhance the removal of hydrophobic contaminants from soil by increasing their mobility and solubility. Experimental work has revealed that large amounts of tetrachlorobiphenyl and hexachlorobiphenyl, as well as naphthalene, anthracene, fluorene and phenanthrene can be removed from soil columns using partially purified surfactant.

Initiated: 5.90 Final Report Due: 10.93
Total Award: $141 900

140 Novel Approach for the Development of Transgenic Plants Resistant to Pathogens: an Alternative to Reduce the use of Chemical Pesticides

M.G. AbouHaider

Department of Biology
University of Toronto
Toronto, ON
M5S 3B2

ER 513G

Development of transgenic plants resistant to economically important viruses. Once the ribozyme sequence corresponding to the RNA polymerase of these viruses is synthesized *in vitro*, it can then be introduced into the plant genetic material ultimately producing transgenic plants. Upon plant exposure to the virus, the complementary sequence of the viral polymerase gene would be recognized and the viral RNA cut at the specified site. This would result in the inhibition of viral replication and the protection of the plant.

Initiated: 12.90 Final Report Due: 5.94
Total Award: $96 750

141 Interaction of Polycyclic Aromatic Hydrocarbons with Higher Plants: Bioconcentration, Phytotoxicity and Development of a Phytotoxicity Assay

B. Greenberg

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 520G

Assessment of the impact of intact and photomodified polycyclic aromatic hydrocarbons on the aquatic higher plant *Lemna gibba*. PAH photoproducts were determined to be more toxic than their parent compounds. Since current environment loads of PAHs are based entirely on the intact chemicals, the severity of PAH effects are very likely to be underestimated. This also demonstrates that photoprocesses cannot be ignored when evaluating the impacts of a potentially hazardous contaminant.

Initiated: 12.90 Final Report Due: 6.92
Total Award: $38 310

142 Validation of Pulmonary Mutagenicity as an Index of Pulmonary Carcinogenicity

J.A. Heddle

Department of Biology
York University
4700 Keele St.
North York, ON
M3J 1P3

ER 522G

Validation of two new assays for inhaled carcinogens particularly with respect to variables such as subject age, species specificity and exposure rate. These assays measure the frequency of gene mutations and chromosomal aberrations associated with carcinogenic initiation in lung cells. One important aspect of this validation is its extension to the testing of carcinogenic PAHs and their non-carcinogenic analogues.

Initiated: 1.91 Final Report Due: 7.94
Total Award: $197 304

Projects Approved During 1990/91

Air Quality

143 Sugar Maple Decline and Corresponding Chemical Changes in Major Polymers in the Stem Tissue (Carbohydrates, Lignins and Trace Elements)

D.N. Roy

Department of Forestry
University of Toronto
Toronto, ON
M5S 1A4

ER 524G

Investigation of a possible correlation of sugar maple decline with chemical changes in sap and wood composition at 10 Ontario sites. This chemical index would indicate onset of the disorder prior to its physical appearance. It could therefore become a useful diagnostic assay for "early warning" of decline syndrome in maple stands. Desirable management strategies could then be implemented in a timely fashion to avert possible fatal consequences.

Completion Date: 6.94
Total Award: $88 950

144 Development of Bioassay Protocols for Toxicants in Soil

Atomic Energy of Canada Ltd.
S. Sheppard

Whiteshell Nuclear Laboratories
Pinawa, MB
R0E 1L0

ER 525C

Development of bioassay protocols in three classes of biota (plants, invertebrates and micro-organisms) for selected soil contaminants such as heavy metals and organic pesticides. This test protocol will be sensitive, yet robust, and will reflect the impact of contamination on biota more accurately than conventional methodology based on total-soil concentrations of contaminants.

Completion Date: 11.92
Total Award: $93 663

145 Review and Development of Methods for Measuring Mercury in Air and Precipitation

ORTECH International
N.D. Johnson

2395 Speakman Dr.
Mississauga, ON
L5K 1B3

ER 526C

Development of a prototype sampling unit and analytical procedure to determine the mercury content of precipitation. This technique will be useful in determining the contribution of precipitation in the overall deposition of atmospheric mercury to land and water surfaces. In conjunction with other input modes, such measurement data can be used to assess impacts of mercury on fish and other biota in the Great Lakes and other areas remote from known sources.

Completion Date: 3.94
Total Award: $114 500

146 Health Effects of Air Pollution Assessed Using Ontario Health Survey Data

L.D. Pengelly

Institute of Environment and Health
McMaster University
1200 Main St. W.
Hamilton, ON
L8N 3Z5

ER 527G

Correlation of the health of residents in various Ontario Public Health Units (PHUs) and air quality parameters derived from the provincial Air Quality Index network. Using analysis of variance and stepwise linear regression techniques, the relative strength of these factors in accounting for the variability of health parameters among people in different PHUs can be determined. These results will also be directly applicable in the setting of future air pollution standards in Ontario.

Completion Date: 6.92
Total Award: $45 000

147 Dense Gas Dispersion Modelling Including Buildings and Obstacles

Envirotech Research Ltd.
S.R. Ramsay

1386 Hastings Dr.
London, ON
N5X 1B1

ER 528C

Further development of analytical and numerical models to describe the effects of topography and obstacles on dense gas dispersion. This is to be achieved through an extensive review of existing theoretical, experimental and field data. In conjunction with project ER 479C, this is leading to the development of a dense gas dispersion model suitable for operation in the presence of difficult topography and obstacles such as buildings. Such a model would be applicable to operational emergency management in situations such as the accidental release of toxic gases and vapours.

Completion Date: 9.92
Total Award: $33 925

148 A Long Range Transport Model with a Nested Fine Resolution Grid — Phase 2

The MEP Company
M. Niewiadomski

Unit 4, 410 Bentley St.
Markham, ON
L3R 9T2

ER 529C

Improvements to the ADOM/GESIMA modelling system based on experience gained during Phase 1 (ER 475C) and newly available data. Simulations of several new pollution episodes including one from the August 1988 high ozone episode will also be made. This approach will validate the model and increase understanding of these particular cases. This would represent a further step in the development of an operational air pollution and deposition model that could be utilized anywhere in North America.

Completion Date: 6.92
Total Award: $73 766

149 Measurements of Natural and Anthropogenic Volatile Organic Compounds in the Regional Atmosphere

Dr. H. Niki

Industrial Research Chair in Atmospheric Chemistry
York University
4700 Keele St.
North York, ON

ER 530G

Measurement of biogenic and anthropogenic VOCs in air samples collected from appropriate forested areas. This will result in better temporally and spatially resolved data than that available at present. The study forms part of the Canadian Oxidant Research Program and will contribute to a greater understanding of atmospheric chemistry in representative rural Canadian settings.

Completion Date: 6.94
Total Award: $265 000

150 Studies of Oxidant Formation in Rural Areas in Ontario

D.R. Hastie

Department of Chemistry
York University
4700 Keele St.
North York, ON

ER 531G

Measurement of reactant nitrogen oxides and organic and inorganic oxidation products at Dorset, Ont. This data will be used as the basis of a model for simulating oxidant chemistry. The relative contribution of natural and anthropogenic hydrocarbons to oxidant formation under a variety of meteorological and emission conditions can then be determined. This unique data set will enable evaluation of chemical and meteorological factors influencing oxidant formation at this and other rural sites in Ontario.

Completion Date: 6.94
Total Award: $346 825

151 Ozone Depletion by CFCs and UVB Increases over Ontario

W.F.J. Evans

Environmental and Resource Studies
Trent University
Peterborough, ON
K9J 7B8

ER 532G

Quantification of past depletion of the ozone layer and associated changes in UVB radiation through model calculations based on data from several sources including satellites. It will also be possible to predict future changes in these parameters. This will facilitate the estimate of increases in skin cancer and the attendant health costs due to this environmental damage.

Completion Date: 6.94
Total Award: $69 000

152 Physical Model Simulation of Concentration Fluctuations

RWDI Inc.
A.E. Davis

650 Woodlawn Rd. W.
Guelph, ON
N1K 1B8

ER 533C

Comparison of short-term gas concentration fluctuations in a wind tunnel physical model with data collected by the ministry's mobile air monitoring unit. These wind tunnel simulations will demonstrate the applicability of physical modelling to a number of areas where short term concentrations are important such as in odour assessment. It will also provide confidence limits for the application of wind tunnel simulations in such studies.

Completion Date: 6.92
Total Award: $76 000

153 Efflux of Trace Greenhouse Gases from Agricultural Sites into the Atmosphere

G.W. Thurtell

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 534G

Use of tunable diode laser technology to measure fluxes of trace greenhouse gases such as methane and nitrous oxides emanating from agricultural locations. After an initial survey of sites, the influence of factors such as soil type and fertilizer application will be assessed. In association with other studies, this could lead to the development of improved management practices to reduce the contribution of emissions from these sources to ozone depletion and global warming.

Completion Date: 6.94
Total Award: $282 080

Water Quality

154 Impact of Livestock Manure and Fertilizer Application on Nitrate Contamination of Groundwater

R.G. Kachanoski

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 488G

Movement of nitrate and dissolved organic carbon into groundwater from manures of differing carbon/nitrogen characteristics in comparison to nitrate leaching from nitrogen fertilizer. Manures may provide more dissolved organic carbon to promote the denitrification process below the root zone thereby lessening the contribution of nitrate to groundwater. This information will help to formulate recommendations for manure management on livestock farms in Ontario.

Completion Date: 4.94
Total Award: $212 690

155 Development of a Novel Photocatalytic Reactor for Mineralization of Water Pollutants

H. de Lasa

Faculty of Engineering Science
University of Western Ontario
1151 Richmond St.
London, ON
N6A 3K7

ER 557G

Feasibility and technical study of a novel photocatalytic reactor involving embedded TiO_2 in glass mesh for the mineralization of water pollutants. This reactor will be based on a new concept where various design characteristics (fluid dynamics, illumination, catalyst loading) are optimized in order to develop a unit configuration with unique prospects for achieving high yields of converted pollutants.

Completion Date: 6.92
Total Award: $114 775*

156 A Study of the Suspended Fluvial Sediments with Enteric Bacteria in Agricultural Drains

D. Hayman

Upper Thames Conservation Authority
P.O. Box 6278, Station D
London, ON
N5W 5S1

ER 558G

Determination of the degree of colonization of suspended stream sediments by enteric bacteria originating in manure. Coupled with this is analysis of the concentration of surface sediment associated nutrients such as soluble carbon, nitrogen and phosphorus. This data will have significance to the ministry's Rural Beaches Strategy Program. Such sediments may be a significant means of transport for these contaminants into recreational water.

Completion Date: 12.92
Total Award: $35 000*

157 Fate of Contaminants in Municipal Pollution Control Plants

D. Mackay

Institute for Environmental Studies
University of Toronto
Toronto, ON
M5S 1A4

ER 559G

Development of a model on the fate and removability of toxic and persistent organic substances in municipal pollution control plants. These substances vary greatly in properties and thus are subject to different treatabilities being variously discharged in the air, sludge and effluent, or degraded during treatment. This simple generic model will provide guidance to the ministry, municipalities and industry about the likely fate of new and existing hazardous chemicals in treatment facilities.

Completion Date: 1.92
Total Award: $39 000*

158 Mechanisms of the Photodegradation of Organic Pollutants from Wastewaters in Homogeneous and Heterogeneous Systems Using Ultraviolet Light

J.W. Bolton

Department of Chemistry
University of Western Ontario
1151 Richmond St.
London, ON
N6A 3K7

ER 560G

Determination of the primary photoprocesses by which organic pollutants can be eliminated from wastewaters using direct homogeneous and heterogeneous UV photolysis. This process is an attractive alternative technology because the pollutants can be almost completely destroyed with few, if any, adverse effects on the environment.

Completion Date: 12.92
Total Award: $147 230*

159 Remote Detection of Hydrocarbon Fuel Contaminants in the Subsurface

J.D. Redman

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 561G

Development of a sound physical basis for evaluating the effectiveness of electrical property based geophysical methods for hydrocarbon determination. By determining typical electrical properties signatures of normal and hydrocarbon fuel contaminated soils, it will be possible to assess the applicability of ground penetrating radar and conductivity mapping techniques to the detection of hydrocarbon fuel contaminants in soil.

Completion Date: 12.92
Total Award: $52 145*

160 Evaluation of a Streptococcus faecium subsp. casseliflavus Model to Assess Pollution Sources at the Kelso Conservation Area

P.L. Seyfried

Department of Microbiology
University of Toronto
Toronto, ON
M5S 1A8

ER 562G

Monitoring of concentrations of *Escherichia coli* (EC), *Streptococcus faecium* subsp. *casseliflavus* (SC) and other indicator bacteria in waterways exposed to animal pollution sources and municipal sewage treatment plant effluent. This will allow an evaluation of the EC/SC ratio as an indicator of human versus animal pollution. It will also provide water quality management personnel with data on the kinds of bacterial indicators that are unique to wildlife.

Completion Date: 12.92
Total Award: $37 000*

161 Comparison of Liquid Manure Spreading Practices on Tile Drain Water Quality

D.M. Dean

Ausable-Bayfield Conservation Authority
P.O. Box 2410
Exeter, ON
N0M 1S7

ER 563G

Assessment of the effect of different methods and timing of manure application and tillage treatments prior to application on groundwater contamination by bacteria and nutrients. This could lead to identification of possible ways of reducing the impact of liquid manure application on tile drain water quality.

Completion Date: 12.92
Total Award: $98 000*

162 Susceptibility of Groundwater to Contamination: A Case Study with Implications

M. Sanderson

Faculty of Environmental Studies
University of Waterloo
Waterloo, ON
N2L 3G1

ER 564G

A case study of the susceptibility of groundwater to contamination in the middle Grand River valley. The basis for this is the consideration of the geological systems and levels of contamination from various past and present land uses in the region. Conclusions as to the impact of past and present land use on the quality of the groundwater in this area will be made. Recommendations concerning legislation and policies regarding the contamination of groundwater in Ontario will also be offered.

Completion Date: **12.92**
Total Award: **$185 000***

163 Development and Testing of a Body-Burden Based Model for Estimating the Toxicity of Mixtures of Organic Contaminants in Fish

D.G. Dixon

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 566G

Development and validation of a dynamic model employing a whole-body-residue based first order kinetic approach. This will be used to generate critical body residue associated with a toxicant endpoint in fathead minnow. The model will aid the ministry in establishing water quality guidelines. It will allow a more comprehensive evaluation of the potential toxicity of complex mixtures of organic contaminants than is possible with current techniques.

Completion Date: **12.92**
Total Award: **$79 264***

164 Relative Value of Fishmarkers, <u>in vitro</u> Chemical Assays and Waterborne AOX Measurements for Evaluating Toxicity of Pulp Mill Effluents

G. Van Der Kraak

Department of Zoology
University of Guelph
Guelph, ON
N1G 2W1

ER 567G

An examination of physiological biomarkers in fish downstream from 14 Ontario pulp mills to determine the prevalence of biological impacts of mill effluent. Facilities evaluated in the study include kraft, TMP and sulfite mills. This study will provide government agencies with the first wide scale study of pulp mill effluent impacts. It will also allow an evaluation of the effectiveness of secondary treatment in eliminating significant effects on aquatic resources.

Completion Date: **2.93**
Total Award: **$50 000***

165 Regionalization of Low Flow Characteristics for the Northeastern and Northwestern Regions

Cumming Cockburn Ltd.
H.S. Belore

145 Sparks Ave.
Willowdale, ON
M2H 2S5

ER 575C

Development and refinement of methodology incorporating a database and statistical techniques to predict low flow characteristics for unguaged watersheds. This information is necessary in the setting of effluent discharge limits from municipal and industrial sources. The resulting prediction technique will be suitable for the estimation of extreme value low flows at unguaged locations in northeastern and northwestern regions of Ontario. This will assist in the management of point and non point sources of pollution.

Completion Date: **6.93**
Total Award: **$122 000**

166 Mercury Flux and Bioconcentration

D.J. McQueen

Department of Biology
York University
4700 Keele St.
North York, ON

ER 576C

Assessment of the relative impacts of variations in food-web structure (from microbes to fish), chemistry and geochemistry on the concentrations, flux rates, activity pathways and rates of bioconcentration of mercury in a number of Dorset Area lakes. This study will contribute to the understanding of the rates and pathways of mercury bioaccumulation in lakes in this area, some of which are among the most heavily mercury contaminated lakes in the world.

Completion Date: **6.94**
Total Award: **$125 280**

167 Fate of Volatile Organic Compounds in Wastewater Collection Systems

R.L. Corsi

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 577G

Study of gas-liquid transfer, biodegradation and adsorption of VOCs in operating sewers through field experiments and computational analysis. Data will be used to develop and evaluate a VOC fate model for wastewater collection systems. This could identify combinations of sewer characteristics, wastewater flow and fluid properties, gas ventilation patterns and VOC properties that lead to significant VOC emissions. This model will be useful in the development and implementation of VOC discharge and control strategies.

Completion Date: **6.94**
Total Award: **$161 524**

168 Hydrogeology of the Oak Ridges Moraine

K.W.F. Howard

Groundwater Research Group
Scarborough Campus, University of Toronto
1265 Military Trail
Scarborough, ON
M1C 1A4

ER 578G

Comprehensive determination of the geology and hydrogeology of the Oak Ridge Moraine, an important groundwater recharge area and watercourse source. A working numerical groundwater model which will provide the ability to assess the impact of anticipated regional development and climate changes will ultimately be developed from this data. This better understanding of its hydrogeology will be critical to provincial and municipal stewardship and management of this moraine as it faces increasing pressure from urban growth.

Completion Date: **6.94**
Total Award: **$218 500**

169 Spatial and Temporal Analysis of the Occurrence of Herbicide Residue in a Major Southern Ontario Agricultural Watershed

Beak Consultants Ltd.
R. Walker

595 Woolwich St.
Guelph, ON
N1H 3Y5

ER 579C

Analysis, using gas chromatography and immunoassay techniques, of atrazine in runoff at three monitoring sites prior to, during and following application. Factors considered will include spatial factors such as watershed size and land use and temporal factors such as season and runoff timing. Guidelines based on this data and applicable to varying conditions will be useful to surveillance staff in the optimization of herbicide monitoring programs.

Completion Date: **12.92**
Total Award: **$54 080**

170 Chromium in Lakes of Ontario

J.O. Nriagu

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 580G

Determination of the processes that regulate the distribution of Cr(III) and Cr(VI) in precipitation and provincial lake systems. The data obtained from this study will be of immense value as Cr(VI) is significantly more toxic than Cr(III). Hydrogen peroxide, which can catalyze the oxidation of Cr(III) to Cr(VI), will also be assayed. This compound is now widely used by industry in the treatment of industrial and sewage effluent.

Completion Date: 6.94
Total Award: $59 400

171 Nitrate Persistence in Slightly Permeable Sediments in Ontario

R.W. Gillham

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ER 581G

Field investigation of the mobility and persistence of nitrate within slightly permeable overburden materials in Southern Ontario. Confined aquifers overlain by these aquitards are the major source of drinking water for many communities including Guelph and Kitchener. This study will increase the understanding of the fate of nitrogen loaded in the subsurface, and will provide a more advanced scientific basis with which to regulate and manage the problem of groundwater contamination in Ontario.

Completion Date: 6.94
Total Award: $169 500

172 An Integrated NPS Model for Watershed Planning

R.P. Rudra

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 582G

Development of an integrated model for the transport of sediment, nutrients and pesticides in surface and tile drained water from agricultural watersheds. The model can then be used to determine the significant factors that influence this transport and to evaluate remediation measures. This will lead to identification of physiographic conditions, land uses, and soil and crop management practices most likely to contribute to significant non-point source pollution from agricultural regions of southern Ontario.

Completion Date: 6.94
Total Award: $207 000

173 Documentation of the Biological Community of Polishing Ponds (Sutton Concept Sewage Treatment System)

Henderson Paddon Environmental Inc.
J.T. Graham

Suite 212, 945 Third Ave. E.
Owen Sound
N4K 2K8

ER 583C

Identification, quantification and determination of environmental effects on the biotic community in the polishing pond in the Sutton Concept sewage treatment system. This biological population plays a key role in the achievement of high quality effluent. This enhanced fundamental knowledge will be of wide interest as this type of extended aeration system becomes an increasingly popular method of domestic sewage treatment for small municipalities.

Completion Date: 11.92
Total Award: $66 240

174 Development of a Geographic Information System Application for Water Quality Management and Policy Development

Cumming Cockburn Ltd.
T.E. Cooper

145 Sparks Ave.
Willowdale, ON
M2H 2S5

ER 584C

Development of a Geographic Information System application, using PC based hardware and software, incorporating recent developments in agricultural technology. This will be used to assess the impact of land use change on water quality. The model developed would be useful for the identification and management of environmentally sensitive areas and for input into policy development processes.

Completion Date: 8.92
Total Award: $63 500

175 Performance Review of Perforated Pipe-Grass Swale Stormwater Drainage System

Paul Wisner & Associates
J-F. Sabourin

Suite 309, 1800 Bark St
Ottawa, ON
K1V 0W3

ER 585C

Determination of the effectiveness of perforated pipes used in combination with grass swales for the source control of receiving water pollution loadings resulting from stormwater drainage. This system would address the need for development of cost effective stormwater management techniques suitable for the Canadian climate.

Completion Date: **8.92**
Total Award: **$73 034**

176 Benthic Invertebrates as Indicators of the Efficacy of a Heavy Metal Contaminants Cleanup

M. Dickman

Department of Biological Sciences
Brock University
St. Catharines, ON
L2S 3A1

ER 586G

Mapping of the diversity, abundance and frequency of abnormal benthic invertebrates in the Welland River. Results from this survey will be assessed in relation to heavy metal contamination levels in the sediments from upstream and downstream of the Atlas Speciality Steels. Collection of samples before the clean-up of contaminated sediments from this site will indicate specific areas for remediation. Subsequent sampling will allow an assessment of the efficacy of the clean-up.

Completion Date: **6.94**
Total Award: **$56 900**

Liquid and Solid Waste

177 Evaluation of the Capacity of Peat to Attenuate Landfill Leachate

J.L. Richards and Associates Ltd.
J.N. Dick

864 Lady Ellen Place
Ottawa, On
K1Z 5M2

ER 536C

Assessment of the efficacy of peat for the removal of heavy metals, trace organics and micronutrients from landfill leachate in the Ontario climate. This attenuation capability is being assessed through laboratory column experiments and construction and monitoring of a full scale *in situ* field trench. Successful demonstration of this method would provide an inexpensive method for small and large municipalities for the treatment of leachate at landfills.

Completion Date: **6.93**
Total Award: **$84 410**

178 Centrifugal Physical Modelling of Clay Liner Compatability

R.J. Mitchell

Department of Civil Engineering
Queen's University
Kingston, ON
K7L 3N6

ER 537G

Production of a comprehensive suite of data on on the long term performance of clay liners for waste containment using geotechnical modelling centrifuge techniques. With this methodology, the effects of mineralogy, placement conditions and leachate organics can be assessed. Results of this study will provide guidance to ministry personnel and consultants in the selection of clay types and the specification of placement methods for waste containment facilities.

Completion Date: **6.93**
Total Award: **$29 135**

179 Removal of Selenium from Copper Refinery Waste Streams

S.K. Brownstein

Institute for Environmental Chemistry
National Research Council
Ottawa, ON
K1A 0R6

ER 538C

Development of methodology for the removal, and recovery in a concentrated useful form, of selenite from the acidic waste stream from a copper refinery. As selenium has industrial applications in photo voltaics and glass manufacture, a successful method would minimize pollution and result in a saleable product.

Completion Date: 9.92
Total Award: $78 350

180 An Engineered Landfill Liner Utilizing Coal Ash

D.W. Kirk

Department of Chemical Engineering and Applied Chemistry
University of Toronto
Toronto, ON
M5S 1A4

ER 539G

Development and demonstration of a cost effective liner prepared from coal fly ash and a waste lime product for use in municipal solid waste sites. The liner would produce an effective hydraulic barrier and have potentially attractive chemical barrier properties. Due to its alkaline nature, this compounded material would provide additional protection against heavy metals and microbial activity at the landfill-environment interface.

Completion Date: 6.93
Total Award: $61 240

181 Reduction of Nitrogen Losses from Animal Manures by Stabilization with Ammonium Adsorbing Minerals

R.P. Voroney

Department of Land Resource Science
University of Guelph
Guelph, ON
N1G 2W1

ER 540G

Characterization of the ammonium exchange properties of various clay materials. The most suitable minerals will be incorporated into an effective treatment and stabilization system for animal wastes. By retaining nitrogen in a non-mobile form, contamination of groundwater and surface water could be reduced. This simple system, using readily available materials, could be implemented immediately in many livestock operations in Ontario.

Completion Date: 6.93
Total Award: $71 790

182 Remediation of Volatile Organic Compounds in Porous Media

J.F. Sykes

Department of Civil Engineering
University of Waterloo
Waterloo, ON
N2L 3G1

ER 541G

Investigation, through laboratory study and numerical model simulations, of the processes and parameters governing the migration of VOCs in porous media. This will result in an increased understanding of the transport mechanisms and interaction of these compounds in both saturated and unsaturated zones. This information will assist in the design of remediation systems for contaminated groundwater at various sites in Ontario.

Completion Date: 6.94
Total Award: $145 410

183 Chemical Oxidation of Coal Tar Residuals Below the Water Table

J.F. Barker

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 542G

Critical evaluation at the laboratory scale of *in situ* remediation of coal tar residuals using strong oxidizing chemicals such as peroxide and permanganate. Once the compounds oxidized and those resistant, and the approximate rates and products of oxidation have been identified, a field demonstration and evaluation will be subsequently undertaken. A successful method would be in demand as these residuals are often found below the water table where removal by excavation is impossible.

Completion Date: 6.93
Total Award: $68 500

184 Microbiological Indicators for Assessing Hydraulic Connection in Buried High Permeability Zones at Waste Disposal Sites

M. Holder-Franklin

Department of Biological Sciences
University of Windsor
Windsor, ON
N9B 3P4

ER 543G

Development of methodology to track bacteria through groundwater at landfill sites and in high permeable zones using numerical taxonomy and specific gene identifiers. This development, using the indigenous population of bacteria as indicators of movement, would result in improved detection and tracing of contaminant plumes.

Completion Date: 6.94
Total Award: $149 213

185 Development of a Novel Procedure to Disinfect Biomedical Waste

P.L. Seyfried

Department of Microbiology
University of Toronto
Toronto, ON
M5S 1A8

ER 544G

Evaluation of the efficacy of a new disinfectant VBF in conjunction with a novel (volume reduction) Bio-Nurbel crushing machine for the decontamination of plastic biomedical waste. Viral, bacterial, fungal and amoebic indicators will be used for this purpose. This combination procedure has particular potential for use in small hospitals, medical clinics and veterinary hospitals. The Bio-Nurbel is smaller than existing comparable machinery and VBF is safer for the environment than agents such as sodium hypochlorite.

Completion Date: 6.92
Total Award: $41 000

186 New Process for the Recovery of Chromium from Electroplating Wastes Using Liquid Membrane Pertraction

M.D. Pritzker

Department of Chemical Engineering
University of Waterloo
Waterloo, ON
N2G 3L1

ER 545G

Evaluation and assessment of techno-economic feasibility of liquid membrane pertraction for the recovery, recycling and reuse of chromium from electroplating wastes. This membrane process shows promise in reducing toxic Cr(VI) content of liquid electroplating wastes to permissible discharge levels without generating any solid waste. At the same time, the recovery and concentration of sufficient Cr(VI) would be possible so that it could be recycled directly and reused in the electroplating facility.

Completion Date: 6.93
Total Award: $78 683

187 Enhanced in situ Bioremediation of Groundwater Contaminated with Chlorinated Solvents Using a Permeable Nutrient Delivery Wall

J.F. Barker

Department of Earth Sciences
University of Waterloo
Waterloo, ON
N2L 3G1

ER 546G

Development and critical evaluation of a method for treating dissolved chlorinated solvents in groundwater. The technique involves the degradation of target organic contaminants by the stimulation of organisms naturally present in aquifers. This is achieved by injection of selected nutrients and/or substrates into the contaminant plume to impose favourable localised reducing conditions. A suitable decontamination method would be extremely valuable as chlorinated solvents pose a particular remediation problem with their deep penetration of aquifers.

Completion Date: 6.94
Total Award: $72 500

188 Movement of Agricultural and Domestic Waste Water Bacteria Through Soils

H. Lee

Department of Environmental Biology
University of Guelph
Guelph, ON
N1G 2W1

ER 547G

Mathematical modelling using tracer bacteria of the pathways and processes that contribute to bacterial movement through unsaturated soils. Focus is on bacterial movement arising from the application of liquid agricultural wastes or septic tank effluents. Biological contamination of surface and groundwater is a significant problem in Ontario. Results from this study

should contribute to improved guidelines regarding agricultural waste discharge and design of septic tank tile drain systems.

Completion Date: 6.94
Total Award: $200 500

Analytical Methods and Instrument Development

189 Development of a Surrogate Analyzer for Volatile Halogenated Organics in Water

G. Hayward

School of Engineering
University of Guelph
Guelph, ON
N1G 2W1

ER 565G

Prototype development of an analyzer for the surrogate measurement of the VHO concentration in water. Based on a selective liquid membrane coupled to a selective electron capture detector, this prototype will be used to establish detection limits for these compounds. This technology could be used as a field prescreening tool for samples to determine whether further quantification by more sophisticated and expensive equipment is necessary. Applications would include waste treatment plant monitoring, effluent monitoring, groundwater and potability testing.

Completion Date: 3.93
Total Award: $35 000*

190 Development of Inductively Coupled Plasma-Mass Spectrometry for the Determination of Trace Metals in Environmental Samples

D. Beauchemin

Department of Chemistry
Queen's University
Kingston, ON
K7L 3N6

ER 568G

Improvement of the analytical capabilities of inductively coupled plasma-mass spectrometry using flow injection techniques for trace metal determination. The resulting technique will have an extended range of applications. It will allow the direct analysis of trace elements in a wide variety of environmental samples including those containing high concentrations of salts. Reduced sample sizes and increased sensitivity will be a feature of this improved methodology.

Completion Date: 6.92
Total Award: $23 500

191 The Thermal Desorption of Solid Phase Extraction Columns for the Low Level Measurement of Organic Compounds in Water

Paracel Laboratories Ltd.
K.J. Falk

Suite 100, 2319 St. Laurent Blvd.
Ottawa, ON
K1G 4K6

ER 569C

Development and evaluation of a usable technique to directly introduce analyte from a solid phase extraction (SPE) column to a gas chromatograph. Focus will be on the optimization of the recovery and reduction of interferences. Such a development is desirable as new low level organic contaminants are discovered or guidelines for known compounds are modified. This increases the demand for more economic and versatile analytical methods with enhanced sensitivity.

Completion Date: 4.92
Total Award: $70 000

192 Pilot Study for the Development of a Biological Certified Reference Material for Organochlorine Contaminants

K.W.M. Siu

National Research Council
Ottawa, ON
K1A 0R6

ER 570C

Identification and pilot scale production of suitable biological materials for use as Certified Reference Material (CRM) for organochlorine pollutants such as PCBs, PCDDs and PCDFs. Currently, no biological CRMs exist for these compounds. Development of CRMs for these organochlorine contaminants is vital as CRMs play a crucial role in analytical method validation, quality assurance and legislative support relating to pollution detection and control.

Completion Date: 6.92
Total Award: $55 263

193 Development of Particle Beam Mass Spectrometric Methods for the Determination of Environmental Contaminants

I.D. Brindle

Department of Chemistry
Brock University
St. Catharines, ON
L2S 3A1

ER 571G

Construction and evaluation of a high pressure liquid chromatography/mass spectrometry interface with particle beam delivery system for the analysis of contaminants such as carbamates and organophosphorus derivatives. Mass spectrometric methods are being increasingly viewed as the superior method for the identification and determination of environmental contaminants. This development would enable analysis of the approximately 80% of organic contaminants not accessible by gas chromatography/mass spectrometry techniques since it is not dependent on volatility and thermal stability.

Completion Date: 6.93
Total Award: $123 300

194 MIFDS: A Microwave Interrupted-Flow Digestion System

E.D. Salin

Department of Chemistry
McGill University
801 rue Sherbrooke ouest
Montreal, PQ
H3A 2K6

ER 572G

Further development and evaluation of the potential and application of microwave digestion for preparation of samples ranging from geologicals (estuary sediments) through oil and sludge. This methodology, ultimately able to be totally automated, would lead to reduced sample analysis cost, increased sample throughput, improved quality of sample preparation and a decrease in laboratory hazards.

Completion Date: 6.94
Total Award: $124 500

195 Development of DNA Probe(s) for the Detection of Bifidobacterium spp. in Water: Phase II

Beak Consultants Ltd.
R. Lifshitz

14 Abacus Rd.
Brampton, ON
L6T 5B7

ER 573C

Continuation of the development of reliable DNA probes for *Bifidobacterium* spp. Specificity and sensitivity will be assessed using reference strains, fresh environmental isolates and spiked environmental samples. Development of reliable genetic probes for *Bifidobacterium* spp would be a major step towards the ability to rapidly and cost effectively establish the sources of bacterial pollution thereby distinguishing between human and animal pollution.

Completion Date: 7.92
Total Award: $49 555

196 Unique Flow Injection Sample Introduction for Plasma Spectrometry

E.D. Salin

Department of Chemistry
McGill University
801 rue Sherbrooke ouest
Montreal, PQ
H3A 2K6

ER 574G

Continued development and performance evaluation of a flow injection interface for atomic spectrometry specifically for trace metal analysis. A prototype and final system will be made available to the ministry for evaluation and use in water contamination monitoring and research studies. This system would lower detection limits by up to 1000 fold, reduce interferences, increase sample throughput and reduce per sample cost compared to existing atomic spectrometry technology.

Completion Date: 6.94
Total Award: $145 000

Environmental Socio-Economics

197 Municipalities and the Environment, a One-Year Feasibility Study

A. Crowder

Department of Biology
Queen's University
Kingston, ON
K7L 3N0

ER 548G

Conduct of a workshop on municipal decisions and the environment involving urban and rural municipalities. This will be accompanied by an assessment of municipal attitudes to the Stage 1 Plan for the Bay of Quinte Remedial Action Plan through a survey of relevant personnel at these organizations. These endeavours will suggest new directions for sustainable development in eastern Ontario, assist the ministry by providing analyses of attitudes, and generate stimuli for academic research and pragmatic policy planning at the regional level.

Completion Date: 6.92
Total Award: $16 720

198 Development of a Computer Model to Determine Environmental Impact of Electric Vehicles in Ontario

W.A. Adams

Electrochemical Science and Technology Centre
University of Ottawa
Ottawa, ON
K1N 6N5

ER 549G

Development of a computer model to evaluate the net environmental effect of the large-scale introduction of electric vehicles in specific Ontario locations. The model, incorporating electricity source, efficiency of energy conversion, quantity of emissions and vehicle use patterns can be used to accurately demonstrate the advantages of electric vehicles. It would also facilitate identification of which regions should, or should not, be encouraged to use this alternative form of transport.

Completion Date: 6.93
Total Award: $60 800

199 Capital Investment Cycles and Environmental Protection

Ernst & Young Management Consultants
A. Shenfeld

P.O. Box 251, Royal Trust Tower, TD Centre
Toronto, ON
M5K 1J7

ER 550C

Determination of the feasibility of monitoring industry capital investment cycles for the identification of the optimum time for the introduction of pollution abatement technology. If, through analysis of available literature on environmental protection costs and past capital expenditures and consultation with industry, this notion proves viable, the timing of implementation of future regulations could be planned so as to minimize the cost to industry of incorporating any necessary technology.

Completion Date: 4.92
Total Award: $52 450

Multimedia Contaminants and Biotechnology

200 Soil Ingestion: Model Parameters for Multimedia Assessment of Heavy Metals

Atomic Energy of Canada Ltd.
S.C. Sheppard

Whiteshell Laboratories
Pinawa, MB
R0E 1L0

ER 551C

Determination of the degree of bioavailability of heavy metals in ingested soil. Central to this is an estimation of the quantity and characteristics of soil retained on hands and food products relevant to pertinent exposure scenarios. This assessment is important as metal concentration in soil particles has been shown to relate inversely to size. These studies will provide the parameters needed to more accurately model the soil ingestion pathway and allow realistic multimedia impact assessments.

Completion Date: 12.93
Total Award: $122 845

201 Contingency Planning for Accidentally Released Genetically-Engineered Microorganisms in the Environment

J.A. Trevors

Department of Environmental Biology
University of Guelph
Guelph, ON
N1G 2W1

ER 552G

Conduct of a literature search and consultative process to produce a review paper on all aspects of genetically-engineered microorganism (GEM) inactivation and site decontamination. Subsequently, it is proposed to undertake laboratory simulations of the accidental release of GEMs to assess methods for their destruction or containment. This will allow local contingency plans to be harmonized with those of other countries and promote public confidence in the use of biotechnology products.

Completion Date: 6.94
Total Award: $198 000

202 Development of the Trap-Treatment-Release Techniques for Pesticide Minimized Termite Colony Control

T.G. Myles

Faculty of Forestry
University of Toronto
Toronto, ON
M5S 1A4

ER 553G

Identification of appropriate trapping techniques and delayed mortality inducing treatments for use as components of the Trap-Treatment-Release termite control technique. Development of this system would provide an environmentally acceptable altemative to the use of high concentrations of persistent soil termiticides in close proximity to human habitation.

Completion Date: 6.92
Total Award: $50 000

203 Biological Risk due to Mixtures of Hazardous Chemicals

D.M. Logan

Department of Biology
York University
4700 Keele St.
North York, ON
M3J 1P3

ER 554G

Evaluation of the general applicability of a mathematical approach to the prediction of biological responses to pairs and mixtures of hazardous chemicals. Exposure to combinations of chemicals more closely approximates natural situations, but to date has proven impossible to accurately model. Success will demonstrate that biological response to mixtures is amenable to quantitative analysis.

Completion Date: 6.92
Total Award: $8 795

204 Analysis of Photooxidation of Polycyclic Aromatic Hydrocarbons (PAHs) Under Environmentally Relevant Conditions and Interactions of Photomodified PAHs with Higher Plants

B.M. Greenberg

Department of Biology
University of Waterloo
Waterloo, ON
N2L 3G1

ER 555G

Continuation of research on the interaction of PAHs with higher plants. Focus is on the investigation of the kinetics and products of PAH photodegradation, and the toxic effects of these photomodified PAHs in *Lemna gibba*. Light, in particular UV, has been found to activate PAHs to more hazardous contaminants. Since plants cannot avoid UV light, they are a potential entry point for intact and photomodified PAHs into the food chain.

Completion Date: 6.92
Total Award: $40 270

205 Heavy Metals in Soils — A Multimedia Risk Assessment Model for Regulatory Use.

Atomic Energy of Canada Ltd.
M. Sheppard

Whiteshell Laboratories
Pinawa, MB
R0E 1L0

ER 556C

Assessment of the capability of the Soil Chemical Exchange and Migration of Radionuclides model to predict the transport and migration of heavy metals in soil. This would complement existing models that reliably predict the behaviour of organic contaminants in soils and multimedia. It could be used in the screening and evaluation of remedial measures for site contamination or in the siting of new landfill sites to avoid undesirable soil conditions.

Completion Date: **6.92**
Total Award: **$31 115**

Reports of Environmental Research Program Projects

Upon completion, investigators responsible for projects supported by the Environmental Research Program must provide a final report. Final reports may or may not be published and made available for circulation. In some instances, scientific or technical papers may be accepted in lieu of this report.

The following listing details those reports currently in circulation. For further information, contact the ministry's Public Information Centre at (416) 323-4321.

Air Quality

206 *Mercury in the Atmosphere.* Ontario Research Foundation. 1978. 94 Pp. (ER 14C)

207 *A Report on Environmental Noise in Ontario and Its Description with Reference to Health Related Effects.* Weinstein, W., SNC/GECO Canada Inc. 1980. 300 Pp. (ER 15C)

208 *The Hamilton Study: The Effect of Environmental Factors on The Respiratory Health of School Children.* Kerigan, A.T., Pengelly, L.D., Goldsmith, C.H. and Garside, B.K., McMaster University. 1983. 264 Pp. (ER 20G)

209 *An Assessment of Street Dust and Other Sources of Airborne Particulate Matter in Hamilton, Ontario.* Hunt, Concord Scientific Corporation. 1982. 305 Pp. (ER 32G)

210 *Lead and Cadmium in Human Disease Processes.* Cherry, W.H., University of Waterloo. 1982. 20 Pp. (ER 33G)

211 *Surface Photochemistry of Adsorbed Organic Species.* Johnston, L.J. and de Mayo, P., University of Western Ontario. 1982. 16 Pp. (ER 34G)

212 *Precipitation Sampler Comparative Study.* Stevens, Concord Scientific Corporation. 1980. 63 Pp. (ER 35G)

213 *Sleep Disturbance Effects of Road Taffic Noise.* Wilson, S.S., S.S. Wilson and Associates. 1984. 38 Pp. (ER 47C)

214 *Abatement of Sulphur Dioxide Emissions: What are the Costs?* Paine, R.L. and Grima, A.P., University of Toronto. 1984. 67 Pp. (ER 56G)

215 *Environmental Modelling Studies of Hazardous Substances in Ontario.* Cheung B., University of Toronto. 211 Pp. (ER 68G)

216 *A Mass Spectrometric Study of Selected Air Pollutants.* March, R.E., Trent University. 1983. 43 Pp. (ER 69G)

217 *Dose Response Relationship of O_3 and Yield in Potato and Peanut.* Hofstra, G. *et al.*, University of Guelph. 1985. 13 Pp. (ER 72G)

218 *Sweet Corn, Cabbage, Cauliflower and Rutabaga Responses to Air Pollution in Southern Ontario.* Ormrod, D.P., University of Guelph. 1985. 22 Pp. (ER 73G)

219 *Development of a Tunable Diode Laser Based Hydrogen Peroxide Monitor.* Hastie, D.R. and Schiff, H.I., York University. 1984. (ER 79G)

220 *Methods of Sampling and Analysis of Asbestos Air Pollution in Ontario.* Verma, D.K., McMaster University. 1987. 25 Pp. (ER 83G)

221 *Inhalable Particulate Network - Standard Operating Procedures and Technical Manual.* Hicks, J. and Steer, P., MacLaren Plansearch Inc. 1987. 28 Pp. (ER 88G)

222 *Combustion Testing Program at the SWARU Plant, Hamilton-Wentworth.* Complin, P.G., Evnirocon Ltd. 1984. 74 Pp. (ER 93C)

223 *A Study of the Health Status of Residents of the Junction Triangle, Toronto.* Spitzer, W.O., McGill University. 1984. 74 Pp. (ER 95G)

224 *Vapour Phase Photochemistry of Chlorinated Aromatic Hydrocarbons.* Bunce, N.J., Landers, J.P. and Langshaw, J., University of Guelph. 27 Pp. (ER 107G)

225 *Modifications to Chemiluminescent Instruments of NO and NO_2 from an Aircraft and a Mobile Laboratory.* Kim, S.W., Hastie, D.R. and Schiff, H.I., York University. 1985. 15 Pp. (ER 110G)

226 *Nickel Carbonyl Ambient Monitor.* Hastie, D.R. and Schiff, H.I., York University. 1988. 14 Pp. (ER 116G)

227 *Investigation of "Short Term Test" Mutagenicity and Chemical Composition of Solvent Extractable Fraction of Coke Oven Emissions.* Thomas, G.H., Horton, A.J. and Craigmile, J., Ontario Research Foundation. 61 Pp. (ER 117C)

228 *Role of Environmental Factors in the Development of Chronic Lung Disease in Smoking and Non-Smoking Adolescents.* Kerigan, A.T. and Pengelly, L.D., McMaster University. 1986. 79 Pp. (ER 119G)

229 *Field and Laboratory Validation of a Hivol Denuder for Minimizing PAH-Oxidant Reactions During Hivol Sampling.* Davis, C.S. *et al.*, Concord Scientific Corporation. 1988. 80 Pp. (ER 123G)

230 *Study of Conditions for Condensation and Desorption of PCDD on Particulate Matter Under Stack Sampling Conditions.* Karasek, F.W. and Dickson, L.C., University of Waterloo. 38 Pp. (ER 129G)

231 *Dose-Response Studies of the Effects of Gaseous and Particulate Pollutants on Food Crops.* Ormrod, D.P., Petitte, J.M. and Marie, B.A., University of Guelph. 83 Pp. (ER 144G)

232 *Feasibility of Determining SO_2 Mass Emission Fluxes by Stackscanning.* Jain, Monitec Ltd. 1985. 40 Pp. (ER 158C)

233 *A Fundamental Study on the Deposition of Aerosols on Cylinders in Turbulent Cross Flows.* Ilias, S. and Douglas, P.L., Queen's University. 20 Pp. (ER 164G)

234 *Assessment of Toxicity of Ingested and Inhaled Haloaromatic Hydrocarbons.* Clark, D.A., Goddard, G. and Sweeney, G.D., McMaster University. 15 Pp. (ER 165G)

235 *An Integrated Approach to the Investigation of Lung Function Responses of Sensitive Subjects to Diverse Air Pollutants.* Silverman, F. and Corey, P., University of Toronto. (ER 173G)

236 *The Hamilton Study: The Effect of Environmental Factors on the Respiratory Health of School Children.* Kerigan, A.T. and Pengelly, L.D., McMaster University. 1983. 13 Pp. (ER 179G)

237 *A Portable Computing System for Use in Toxic Gas Emergencies.* Diamond, G.L. *et al.*, Air Resources Branch, Ontario Ministry of the Environment. 1988. 20 Pp. (ER 183I)

238 *Regional and Evaluative Level III Fugacity Models Describing the Multimedia Environmental Partitioning, Reaction, and Transport of Organic Chemicals.* Mackay, D. and Paterson, S., University of Toronto. 1988. 25 Pp. (ER 194G)

239 *The Mutagenic Activity of Complex Mixtures of PAH's Derived from Air Particulate Matter.* Raj, A.S., York University. 1988. 91 Pp. (ER 220G)

240 *Vector Scoring System for the Prioritization of Environmental Contaminants, Vol.* 1. Willes, R., CanTox Inc. 1988. 75 Pp. (ER 226C)

241 *Vector Scoring System for the Prioritization of Environmental Contaminants, Vol.* 2. Willes, R., CanTox Inc. 1988. 35 Pp. (ER 226C)

242 *Effect of Drought, Aluminum, and Low pH on Growth and Chemical Composition of Sugar Maple Seedlings.* Havas, M. *et al.*, University of Toronto. 1989. 140 Pp. (ER 271G)

243 *Evaluation of a New Filter Media for High Volume Sampling.* Foster, B.A. and Kurtz, J., Laboratory Services Branch and Air Resources Branch respectively, Ontario Ministry of the Environment. 1987. 16 Pp. (ER 289C)

244 *Utilization of Established Air Pollution Monitoring Networks in Ontario Following Nuclear Incidents.* Slade, J.A. and Laszlo, G., Atomic Energy of Canada Ltd. 1988. 68 Pp. (ER 305C)

245 *An Evaluation of the Problems of Particulate Emissions from the Wood Products Industry.* Lepage, M.F. and Davies, A.E., Rowan Williams Davies & Irwin Inc. 1988. 38 Pp. (ER 306C)

246 *Scale Model Studies and the Development of Prediction Procedures for Heavy Gas Dispersion in Complex Terrain.* Irwin, P.A., Rowan Williams Davies & Irwin Inc. 1990. (ER 310C)

247 *Development of Multivariate Analysis Procedures for Ontario Air Quality Data.* P. K. Hopke., University of Illinois at Urbana-Campaign. 1990. 52 Pp. (ER 311G)

248 *Atmospheric Trace Gas Measurements Using A Tunable Diode Laser Absorption Spectrometer.* Hastie, D.R. and Schiff, H.I., York University. 1991. 16 Pp. (ER 314G)

249 *Critical Evaluation of Atmospheric Pollutant Parameterization from Satellite Imagery.* O'Neill, N.T., Royer, A. and Hubert, L., Sherbrooke University. 1990. 75 Pp. (ER 349G)

250 *Feasibility Study for Assessing and Modelling Microclimatic Conditions on the Fonthill Kame.* Shaw, T.B., Brock University. 1988. 59 Pp. (ER 371C)

251 *Method Development for the Monitoring and Analysis of Odorous Organics in Ambient Air - Analysis of Aliphatic Amines.* Mann Testing Laboratories Ltd. 1988. (ER 373C)

252 *Development of Standards for Safe Gas Compositions in Cement Plants.* Wick M L., University of Western Ontario. 1990. (ER 402G)

253 *Evaluation of Methods to Determine the Impacts of Residential Woodburning on Ambient Air in Ontario.* Yandle, M.E., Davis, C.S., and Dougherty, D.L., Concord Scientific Corporation. 1989. 150 Pp. (ER 426C)

Water Quality

254 *Bioaccumulation Rates, Acute and Chronic Effects of New Dielectric Fluid Products on Fish.* Smith, A.D., Orr, D.E. and Ozburn, G.W., Lakehead University. 1979. 31 Pp. (ER 03G)

255 *Chloroform Reduction Investigation Programme at Belleville Utilities Commission.* O'Connor, E.G. and Simmons, R.A.G., Belleville Utilities Commission and Gore & Storrie Ltd., respectively. 1979. 40 Pp. (ER 08G)

256 *Chemical Identification and Biological Assay of Airborne and Waterborne Mutagens.* Katz, M., Heddle, J.A. and Salamone, M.F., York University. 1981. 33 Pp. (ER 10G)

257 *The Uptake of Methylmercury by Walleye (Stizostedion vitreum) Through a Simulated Ecosystem as a Function of Selected pH Regimes.* Smith, J.D., James F. MacLaren Ltd. 1980. 60 Pp. (ER 22C)

258 *Monitoring Fish Populations in Acid Stressed Lakes in the Haliburton Region.* Zimmerman, A.P., University of Toronto. 1978. 35 Pp. (ER 24G)

259 *Ozonation as an Alternative to Chlorination for Drinking Water Disinfection.* Robertson, J.L., IEC Beak Consultants Ltd. 1983. 50 Pp. (ER 27C)

260 *The Effects of Hydraulic Characteristics and Effluent Chlorination on the Incidence of Microorganisms of Public Health Significance in Receiving Waters.* Hodd, S., IEC Beak Consultants Ltd. 1982. 93 Pp. (ER 28C)

261 *Biomonitoring of Organic Compounds in Drinking Water.* Fitchko, J., IEC Beak Consultants Ltd. 1981. 194 Pp. (ER 29C)

262 *Rideau River Stormwater Management Study.* Gietz, R.J., Regional Municipality of Ottawa-Carleton. 1983. 256 Pp. (ER 30C)

263 *Characterization and Identification of Organic Substances in Drinking Water.* Das, B.S. & Thomas, G.H., Ontario Research Foundation. 1980. 138 Pp. (ER 31C)

264 *Report on Rideau River Stormwater Management Study Phase I.* Anderson, J.C. and Perks, A.R. Gore & Storrie and Proctor & Redfern respectively. 1981. 197 Pp. (ER 37C)

265 *Report on Rideau River Stormwater Management Study Phase II.* Anderson, J.A. and Rowney, A.C., Gore & Storrie and Proctor & Redfern respectively. 1983. 124 Pp. (ER 37C)

266 *Bruce and Pickering Thermal Plume Definition Flights.* Brumbaugh, Intertech Remote Sensing Ltd. 11 Pp. (ER 41C)

267 *Aquatic Toxicity of Multiple Organic Compounds 2,4,6 - trichlorophenol.* Ozburn, G., Lakehead University. 1983. 43 Pp. (ER 48G)

268 *Aquatic Toxicity of Multiple Organic Compounds.* Ozburn, G.A., Lakehead University. 1981. 16 Pp. (ER 49G)

269 *Chemical Identification and Biological Assay Studies of Environmental Mutagens, Promoters and Inhibitors.* Katz, M., York University. 1983. 70 Pp. (ER 55G)

270 *Environmental Significance of Sewage Lagoons in Ontario.* Neil, J.H. and Kamaitis, G., Limnos Ltd. 1982. 42 Pp. (ER 57C)

271 *Mutagens in the Environment.* Streb, J.A. and Logan, D.M., York University. 1983. 208 Pp. (ER 59G)

272 *Studies of Nitrate Distributions and Nitrogen Transformations in Shallow Sandy Aquifers.* Starr, R.C. *et al.*, University of Waterloo. 1987. 49 Pp. (ER 62G)

273 *Removal of Hazardous Contaminants in the Hamilton WPCP.* Rush, R., Canviro Consultants Ltd. 1987. 82 Pp. (ER 65C)

274 *Trout Farm Effluent Study.* Hilton, J.W. and Slinger, S.J., University of Guelph. 1984. 26 Pp. (ER 94G)

275 *Evaluation of Data on the Effects of Hydraulic Characteristics and Effluent Chlorination on the Incidence of Micro-Organisms of Public Health Significance in Receiving Waters.* Palmer, Gore & Storrie Ltd. 1988. 64 Pp. (ER 105C)

276 *Volatilization Rates for Organic Chemicals of Public Health Concern.* Gowda, T.P., Halappa and Lock, J.D. Gore & Storrie Ltd. 1984. 30 Pp. (ER 106C)

277 *Heavy Metal Mobilization and Bioavailability - Cobalt Mine Tailings.* Hanna, J.E., J.E. Hanna Associates Inc. 1984. 52 Pp. (ER 108C)

278 *Effect of Metals from Mine Tailings on the Microflora of a Marsh Treatment System.* Seyfried, P.L., University of Toronto. 1986. 164 Pp. (ER 109G)

279 *Ottawa River Nuclear Spill Contingency Model Development.* Palmer, M.D., Gore & Storrie Ltd. 1988. 50 Pp. (ER 111C)

280 *Effect on the Tissue of Young Fish and Rats of Exposure to Lead, Cadmium and Mercury.* Nicholls, D.M., York University. 21 Pp. (ER 114G)

281 *Ozone Treatment and Trace Organic Contaminants in Drinking Water.* Hargrave, W.J., Gore & Storrie Ltd. 1984. 31 Pp. (ER 121C)

282 *Evaluation of the Relationship between Growth and Lipid Deposition in Juvenile Fishes.* Beak Consultants Ltd. 1987. 12 Pp. (ER 125G)

283 *Town of Listowel - Artificial Marsh Project.* Fisher, Town of Listowel. 138 Pp. (ER 128C)

284 *Humber River Water Quality Management Plan 1986.* McLean, MRTCA. 1986. 176 Pp. (ER 136G)

285 *Environmental Epidemiology.* Le Riche, W.H., University of Toronto. 1984. 37 Pp. (ER 140G)

286 *Distribution, Origins and Behaviour of Local Groundwaters Containing Elevated Concentrations of Chlorides.* Howard, K.W.F., University of Waterloo. 1988. 58 Pp. (ER 145G)

287 *Sampling Groundwaters and Surface Waters for Volatile Organic Contaminants.* Barker, J.F., McAlary, T.A. and Travis, G.M., University of Waterloo. 1987. 85. (ER 148G)

288 *A Model of Organic Chemical Fate in a Biological Wastewater Treatment Plant.* Clark, B., Mackay, D., Tasfi, L., Henry, G.L.H. and Salenieks, S., University of Toronto. 1989. 45 Pp.

289 *Impacts of Tile Drainage.* Paine, J.D. and Watt, W.E., Queen's University. 1989. 99 Pp. (ER 152G)

290 *Development of a Methodology for Use of Freshwater Clams as Biological Response System to Monitor the Nearshore Environment of the Lower Great Lakes.* Green, R.H., University of Western Ontario. 1988. (ER 162G)

291 *Demonstration of Kenox Process for Wet Oxidation of Whey.* McCroquodale, Kenox Corporation. 1986. 35 Pp. (ER 166C)

292 *Atikokan Pilot Test.* Constantine, Dillon Consulting Engineers and Planners. 1985. 144 Pp. (ER 168C)

293 *Plant Bioassys for the Detection of Environmental Mutagens.* Grant, W.F., York University. 1987. 22 Pp. (ER 169G)

294 *Sediment and Pollution Accumulation in the Humber River Marsh, Toronto.* Weninger, J.M., University of Toronto. 1988. 54 Pp. (ER 182G)

295 *A Special Hydrocyclone Designed for Sewage Treatment.* Boadway, J.D., Queen's University. 1988. 58 Pp. (ER 184G)

296 *Municipal Waste Recycling Through Forest Plantation Technology for Port Dover, Ontario.* Papadopol, C.S., MacLaren Plansearch. 1985. 47 Pp. (ER 185C)

297 *In Situ Assessment of Copper and Zinc Impacts of White Sucker Populations of the Manitouwadge Chain of Lakes.* Munkittrick, K.R., University of Waterloo. 1989. 208 Pp. (ER 193G)

298 *Degradation of Organic Contaminants by Anaerobic Bacteria in Lake Ontario Sediments.* Urbanek, M., Strycek, T. and Goldner, M., University of Toronto. 1988. 20 Pp. (ER 195G)

299 *Bacteriological Water Quality Study Examining the Impact of Sediment and Survival Times in the Humber River and Black Creek.* Seyfried, P. and Harris, E., University of Toronto and Lake Simcoe and Region Conservation Authority respectively. 1990. 264 Pp. (ER 199G)

300 *Bioaccumulation of Mercury By Young-of-the-Year Yellow Perch: A Bioenergetics Approach.* Post, J.R., University of Wisconsin. 1988. 12 Pp. (ER 199G)

301 *Probability and Stochastic Modelling of Water Quality Parameters in the Thames River.* Graham, V.A. and Unny, T.E., University of Waterloo. 42 Pp. (ER 201G)

302 *Evaluation of Reverse Osmosis Technology for Cheese Whey Concentration.* Jakubiec H.R., Zenon Environmental Inc. 1986. (ER 204C)

303 *The Evaluation of Native Marsh Plant Species for the Treatment of Domestic Sewage.* Neil, J.H. and Graham, J.T., Limnos Ltd. 1988. 48 Pp. (ER 205C)

304 *An Isotopic Investigation Into the Sulphur Cycle in the Plastic Lake Watershed, Dorset, Ontario.* Van Stempvoort D.R., University of Waterloo. 1987. 21 Pp. (ER 228G)

305 *Development of a Standard Biomonitoring Methodology for the Detection of Trace Contaminants within the Waters of the Ontario Great Lakes Region.* Melkic, A., Integrated Explorations. 1991. 76 Pp. (ER 231C)

306 *Ottawa River Nuclear Spill Contingency Model Development.* Klose, S.R., Gore & Storrie. 1988. 39 Pp. (ER 235C)

307 *Computer Based Centralized Control Systems for Water Supply & Sewerage Facilities.* Fowle, Simcoe Engineering Group Ltd. 1988. 42 Pp. (ER 236C)

308 *The Use of Aquatic Vegetation and Invertebrates to Monitor Chlorinated Hydrocarbons in the Lake Huron-Lake Erie Corridor.*, Haffner, D., Gobas, F. and Hebert, P., University of Windsor. 1991. 169 Pp. (ER 241G)

309 *The Uptake and Depuration of Cadmium, Lead and Mercury Concentrations in Cladophora in the Niagara River.* Rang, S. and Stokes, P.M., University of Toronto. 1988. 25 Pp. (ER 248G)

310 *Bioassessment of Contaminated Sediments with Special Reference to Impact on the Microorganisms of the Receiving Water.* Nalewajko, C., Olaveson, M., and Ewing, C., University of Toronto. 1988. 56 Pp. (ER 249G)

311 *An Expert System for Water Quality Assessment.* Unny, T.E. and Allen, W.P., University of Waterloo. 1988. 197 Pp. (ER 250G)

312 *Pathogenesis of Neoplastic Diseases Afflicting Feral Fish.* Hayes, M.A. and Smith, I.R., University of Guelph. 1987. (ER 251G)

313 *Analysis of the Contaminant Plume in the Oak Ridges Aquifer.* Proulx, I. and Farvolden, R.N., University of Waterloo. 1989. 131 Pp. (ER 261G)

314 *Mitigation of Blue-Green Algae in Heart Lake and other Southern Ontario Lakes and Reservoirs.* Molot, L.A., BAR Environmental. 1987. 85 Pp. (ER 264C)

282

315 *Optstor User's Manual.* Zemell, S.H., MacLaren Plansearch Inc. 1988. 37 Pp. (ER 266C)

316 *Lake Water Quality Monitoring Based on Remotely Sensed Data.* Pitblado, J.R., Laurentian University. 1987. 268 Pp. (ER 267G)

317 *Factors Influencing Trace Metal Levels in Zooplankton in Lakes in Ontario.* Mackie, G.L., University of Guelph. 1989. 96 Pp. (ER 269G)

318 *Characteristics of the Fecal Indicator Bacterial Flora of Sanitary Sewage with Application to Identifying the Presence of Sanitary Waste in Storm Sewers.* Seyfried, P. and Bleier, T., University of Toronto. 1991. 329 Pp. (ER 274G)

1657

319 *An Ecosystem Approach to the Monitoring of PCB's in Pristine Lakes in Ontario.* Metcalfe, C.D. and Macdonald, C.R., Trent University. 1990. (ER 275G)

320 *Availability of Zinc to Benthic Organisms From Sediment Fractions.* Fitchko, J., Beak Consultants Ltd. 1988. 25 Pp. (ER 277C)

321 *Town of Kirkland Lake Water Treatment Plant Alternative Process Research.* Fisher, D.R., Proctor and Redfern Ltd. 1988. 26 Pp. (ER 289C)

322 *Low Cost Treatment Technology for Gasoline Contaminated Groundwater-Delta, Ontario.* Woeller, R.M., Devlin, J.F. and Keil, T.R., Water and Earth Science Associates Ltd. 1989. 18 Pp. (ER 291C)

323 *Problem Definition and Assessment of Remedial Measures Gasoline Contaminated Groundwater-Delta, Ontario.* Smith, D.P., Water and Earth Science Associates Ltd. 1986. (ER 291C)

324 *Development of a Chromogenic Reagent for the Specific Detection and Enumeration of Escherichia coli in Environmental Samples.* A.N. Ley, Queen's University. 1988. 12 Pp. (ER 295G)

325 *The Long Term Effects of Acute and Sub-Chronic Pentachlorophenol Exposures on the Growth and Lipid Reserves of Centrarchid Fishes.* Samis, A.J.W., Colgan, P.W. and Hohansen, P.H., Queen's University. 1990. 32 Pp. (ER 318G)

326 *The Investigation, Evaluation, and Recommendations of Biomonitoring Organisms for Procedures Development for Environmental Monitoring.* Jefferson, C., Curry Jefferson Environmental Services. 1988. 65 Pp. (ER 319C)

327 *Biomonitoring Protocols for Adult Aquatic Insects.* Kovats, Z.E., Ciborowski, J.H., and Corkum, L.D., University of Windsor. 1991. 121 Pp. (ER 322G)

328 *An Expert System for Water Quality Assessment of Ontario Rivers.* Unny, T.E. and Allison, W.C., University of Waterloo. 1989. 172 Pp. (ER 332G)

329 *Algal Competition in Steady State Continuous Culture: Response of Anabaena and Scenedesmus to Variations in CO_2 and Iron.* Molot, L. and Trick, C.G., Molot Environmental Services Inc. and University of Western Ontario respectively. 1989. 26 Pp. (ER 337C)

330 *Grey Water Disposal from Pleasure Boats.* Aldworth, G.A., Beak Consultants Ltd. 1991. 60 Pp. (ER 341C)

1422 E01

331 *Relationship of Mercury Levels in Sportfish with Lake Sediment & Water Quality Variables.* Wren, C., BAR Environmental. 1991. 36 Pp. (ER 353C)

332 *Carcinogenic Responses of Wild Fish from Polluted Sites in Lake Ontario.* Hayes, M.A., University of Guelph. 1990. 11 Pp. (ER 358G)

333 *Recent Trends and Historical Changes in Water Quality of Lake Muskoka.* Rybak, M., Areco Canada Inc. 40 Pp. (ER 381C)

113
NO Copies

335 *Assessment of the Biologically Based Low Flow Analysis Technique.* Belore, H.S., Cumming Cockburn Ltd. 1990. 170 Pp. (ER 408C)

336 *Impact of Bleached Kraft Mill Effluent (BKME) on Fish Population Near Terrace Bay, Ontario.* McMaster, M.E, University of Toronto. 1991. 98 Pp. (ER 463G)

337 *Extraction of Zygnematacean Zygospores from Lake Sediments and their Potential as Paleo-Indicators of Lake Acidification.* Zippi, P.A., Yung Y.K., Welbourn, P.M., Norris, G. and McAndrews, J.H., Trent University. 1991. 47 Pp. (ER 464G)

338 *Use of Sequential Sampling of Amphipod Abundance to Classify the Biotic Integrity of Acid-Sensitive Lakes.* France, R., W.D.N.R.G. Limnetics Ltd. 1991. 21 Pp. (ER 470C)

Liquid and Solid Waste

339 *Contamination of Vegetation and Soil by Lead and Other Elements in the Vicinity of the Canada Metal Company, Eastern Avenue, Toronto - 1983, 1984, 1985.* Rinne, R.J., Air Resources Branch, Ontario Ministry of the Environment. 1986. 5 Pp. (ER O1C)

340 *The Chemical Characteristics of Mineral Tailings in the Province of Ontario.* Hawley, J.R., Waste Management Branch, Ontario Ministry of the Environment. 1979. 234 Pp. (ER 02C)

341 *Report on The Environmental Effects of Waste Oil as a Road Dust Suppressant.* Jones, G.A., L.S. Love & Associates Canada Ltd. 1978. 52 Pp. (ER 05C)

342 *Hydrodynamic Containment for the PCB Spill near Dowling, Ontario.* Meneley, W.A., W.A. Meneley Consultants Ltd. 1979. 29 Pp. (ER 09C)

343 *Hydrogeological Studies of a Sandy Aquifer at an Abandoned Landill.* MacFarlane, D.S., Cherry, J.A., Gillham, R.W. and Sudicky, E.A., University of Waterloo. 1980. 500 Pp. (ER 16G)

344 *Leachate Patterns: Leachate Transport and Mathematical Modelling of Flow and Contaminant Transport.* Soyupak, S., Farquhar, G., & Sykes, J., University of Waterloo. 1980. 500 Pp. (ER 16G)

345 *Listowel Artificial Marsh Project Report.* Herskowitz, J., Town of Listowel. 1986. 253 Pp. (ER 18G)

346 *The Levels of Uranium and Other Elements in Lichens and Mosses Growing in the Elliot Lake and Agnew Lakes Areas, Ontario, Canada.* Richardson, D.H.S., Nieboer, E. and Beckett, P.J., Laurentian University. 1979. 71 Pp. (ER 19G)

347 *Gas Migration Study.* Nunan, J.P., Hydrology Consultants Limited. 1978. 250 Pp. (ER 23C)

348 *The Chemical Destruction by Sodium Naphthalenide of Polychlorinated Biphenyls Present as Contaminants in Transformer Oil.* Smith, J.G., University of Waterloo. 1980. 14 Pp. (ER 25G)

349 *Study of Environmental Impairment Liability Insurance.* Scott, G.T.G., Scott & Associates. 1980. 15 Pp. (ER 36C)

350 *The Measurement of Total Organic Chlorine in Industrial Wastes.* Bancsi, J.J., Behmann, J. and Benedek, A., McMaster University. 1982. 87 Pp. (ER 39G)

351 *Lichens and Mosses as Monitors of Industrial Activity Associated with Uranium Mining in Northern Ontario, Canada, Vol.* 1. Boileau, L.J.R. *et al.*, McMaster University. 1982. 15 Pp. (ER 43G)

352 *Lichens and Mosses as Monitors of Industrial Activity Associated with Uranium Mining in Northern Ontario, Canada, Vol.* 2. Beckett, P.J. *et al.*, McMaster University. 1982. 16 Pp. (ER 43G)

353 *Lichens and Mosses as Monitors of Industrial Activity Associated with Uranium Mining in Northern Ontario, Canada, Vol.* 3. Nieboer, E., McMaster University. 1982. 11 Pp. (ER 43G)

354 *Attenuation in Groundwater of Inorganic Contaminants from Sanitary Landfills on Sandy Unconfined Aquifers, Vol.* 1. Buszka, P.M., University of Waterloo. 1981. 83 Pp. (ER 44G)

355 *Attenuation in Groundwater of Inorganic Contaminants from Sanitary Landfills on Sandy Unconfined Aquifers, Vol.* 2. Cherry, J.A., Barker, J.F. and Reardon, E.J., University of Waterloo. 1982. 96 Pp. (ER 44G)

356 *Land Disposal of Sewage Sludge.* Soon, Y.K. and Bates, T.E., University of Guelph. 1981. 167 Pp. (ER 46G)

357 *Field Measurement of Infiltration Through Landfill Covers.* Lee, P.K., Gartner Lee Associates Ltd. 1985. 49 Pp. (ER 58C)

358 *Design of Groundwater Monitoring Programs for Waste Landfill Sites.* Byer, P.H. and Schwarz, R.R., University of Toronto. 1984. 32 Pp. (ER 63G)

359 *Extraction & Concentration Method for Testing of Landfill Leachates.* Ontario Research Foundation. 1991. (ER 103C)

360 *Assessing the Impact of Hazardous Immiscible Liquids in Soil.* Farquhar, G.J., McBean, E.A. and Pearson, R.G., University of Waterloo. 1990. 85 Pp. (ER 104C)

361 *The Occurrence and Mobility of Hazardous Organic Chemicals In Groundwater at Several Ontario Landfills.* Barker, J.F., Cherry, J.A. and Reinhard, M., University of Waterloo. 1989. 107 Pp. (ER 118G)

362 *Application of Industrial Liquid Waste to Secondary Roads in Ontario for Dust Control: Implications with Respect to Groundwater Quality.* Gillham, R.W. *et al.*, University of Waterloo. 1985. 77 Pp. (ER 130G)

363 *Numerical Modelling Study of Drain Efficiency in Leachate Collection.* Abdul, A.S., Arnaud, L. St. and Farvolden, R.N., University of Waterloo. 1985. 32 Pp. (ER 131C)

364 *The Fractured Clay Till of Southwestern Ontario: Geotechnical Investigations.* Dusseault, M.B., University of Waterloo. 1988. 103 Pp. (ER 147G)

365 *Determining the Integrity of Solidified Wastes by Large Scale Leach Columns.* Kirk, D.W., University of Toronto. 141 Pp. (ER 156G)

366 *Evaluation of a Prototype RDF Pyrolyser for the Ministry of Energy and the Ministry of the Environment.* Thorndyke, S.J. Ontario Research Foundation / ORTECH International. 1987. 86 Pp. (ER 191C)

367 *Effects of Increasing Amounts of Non-Polar Organic Liquids in Domestic Waste Leachate on the Hydraulic Conductivity of Clay Liners in Southern Ontario, Vol.* 1. Quigley, R.M. and Fernandez, F., University of Western Ontario. 1989. 178 Pp. (ER 213G)

368 *Effects of Increasing Amounts of Non-Polar Organic Liquids in Domestic Waste Leachate on the Hydraulic Conductivity of Clay Liners in Southern Ontario, Vol.* 2. Quigley, R.M. and Fernandez, F., University of Western Ontario. 1989. 352 Pp. (ER 213G)

369 *Evaluation of Contaminant Velocity in Low-Permeability Fractured Shale.* Cherry, J. *et al.*, University of Waterloo. 55 Pp. (ER 214G)

370 *Guidelines for the Utilization of Industrial Wastes in Backfill and Construction Applications.* Canviro Consultants. 1986. 63 Pp. (ER 217C)

371 *Development of Polysulfide Technology for Treatment of Concentrated Spent Cyanide Liquors.* Ganczarczyk, J.J., Bilevicius, S.R. and Tang, G., University of Toronto. 1988. 62 Pp. (ER 233G)

372 *Acute and Chronic Toxicity to Zooplankton of Pure Pentachlorophenol and a Technical Formulation: Laboratory and Field Studies.* Stephenson, G.L. and Kaushik, N.K., University of Guelph. 1991. 44 Pp. (ER 242G)

373 *Acute and Chronic Toxicity to Zooplankton of Pure Pentachlorophenol and a Technical Formulation: Laboratory and Field Studies.* Stephenson, G.L. and Kaushik N.K., University of Guelph. 1991. 54 Pp. (ER 242G)

374 *Treatment of Landfill Leachate by Spray Irrigation (Muskoka Lakes).* McBride, R.A., Gordon, A.M. and Groenevelt, P.H., University of Guelph. 1988. 161 Pp. (ER 244G)

375 *Clay/Leachate Compatibility Study Hydraulic Conductivity of Ottawa/Carleton "Leda" Clay Barrier Soils Permeated with Domestic Waste Leachate.* Quigley, M., Fernandez, F. and Ohikere, C., University of Western Ontario. 1989. 118 Pp. (ER 299G)

376 *Technical and Economic Assessment of Reverse Osmosis for Treatment of Landfill Leachate.* Coburn, J.A., Zenon Environmental Inc. 1989. 88 Pp. (ER 303C)

377 *Manual for Establishing Vegetation on Landfills in Ontario.* Leech, R.E.J. and Hilditch, T.W., Gartner Lee Associates. 1990. (ER 307C)

378 *The Enhanced Sanitary Landfill - Phase I.* The Anaerobic Treatability of Landfill Leachate. Vicevic, G. and Laughlin, R.G.W., ORTECH International. 1989. 71 Pp. (ER 308C)

379 *The Mobility & Persistence of Selected Organic Solutes in Anaerobic Groundwaters & Possible Remediation Measures.* Barker, J.F., University of Waterloo. 1991. 27 Pp. (ER 330G)

380 *Technology Review: Biological Treatment of Hazardous Landfill Leachates.* Fein, J. and Yu, P. Diversified Research Laboratories, Ltd. 1988. 220 Pp. (ER 339C)

381 *Erosion of Municipal Solid Waste Landfill Covers.* McKague, K.J. Ecologistics Ltd. 1989. 83 Pp. (ER 340C)

382 *Effects of Increasing Amounts of Non-Polar Organic Liquids in Domestic Waste Leachate on the Hydraulic Conductivity of Clay Liners in Southern Ontario, Vol.* 1. Quigley, R.M. and Fernandez, F., University of Western Ontario. 1989. 172 Pp. (ER 364G)

383 *Effects of Increasing Amounts of Non-Polar Organic Liquids in Domestic Waste Leachate on the Hydraulic Conductivity of Clay Liners in Southern Ontario, Vol.* 2. Quigley, R.M. and Fernandez, F., University of Western Ontario. 1989. 297 Pp. (ER 364G)

384 *The Design and Evaluation of in situ Biorestoration Methods for the Treatment of Sludges and Soils at Waste Disposal Sites.* Barker, J.F. and Mayfield, C.I., University of Waterloo. 1989. 14 Pp. (ER 369G)

385 *Evaluation of Contaminant Leachibility from Residues Collected at a Refuse Derived Fuel Municipal Waste Combustion Facility.* Sawell, S.E., Constable T.W. and Klicius, R.K., Environment Canada. 1989. 26 Pp. (ER 370C)

386 *Evaluation of Solidified Fabric Filter Ash from a Modular Municipal Waste Incinerator with Lime-Based Air Pollution Control.* Sawell, S.E., Caldwell, R.J., Constable, T.W., Scroggins, R.P. and Klicius R.K., Environment Canada. 1989. 27 Pp. (ER 370C)

387 *Groundwater Monitoring Practices at Landfills: Procedures and Protocols.* Mooij, H., H. Mooij & Associates Ltd. 1989. 57 Pp. (ER 410C)

388 *Glassification and Leachability of Hazardous Wastes and Hazardous Waste Residues.* Harvey, K.B. Atomic Energy of Canada Ltd. 1991. 32 Pp. (ER 411C)

389 *Evaluation of Prototype Landfill Cover Lysimeters.* McKague, K.J., Ecologistics Limited. 1990. 75 Pp. (ER 425C)

390 *Assessment of the Current Waste Management Practices on Farm Operations in Perth County, Ontario.* Haight, M., University of Waterloo. 1989. 30 Pp. (ER 428G)

391 *Quantification of Infiltration Through Landfill Covers.* K.J. McKague, Ecologistics Ltd. 1991. 40 Pp. (ER 440C)

392 *Acute Control Testing of Clay Liner Permeability.* Mitchell, R.J., Queen's University. 1990. 57 Pp. (ER 506C)

Analytical Methods and Instrument Development

393 *Revised Monitoring Scheme for Persistent and Toxic Organics in Great Lakes Sports Fish.* Coburn, J.A., Zenon Environmental Inc. 1985. 42 Pp. (ER 67G)

394 *A Mass Spectrometric Study of Selected Air Pollutants.* March, R.E., Trent University. 1983. 43 Pp. (ER 69G)

395 *Supplementary Analysis of Novel Data Collected During a Survey of Rivers and Beaches in 1983.* Seyfried, P., University of Toronto. 1987. 412 Pp. (ER 89G)

396 *Studies of Methodology and Instrumental Capabilities for Optimum and Rapid Analysis of PCDD and PCDF Compounds in Water.* Karasek, F.W. and Charbonneau, G.M., University of Waterloo. 41 Pp. (ER 102G)

397 *Humber River Bacteriological Study.* Seyfried, P.L. and Harris, E., University of Toronto. 1987. 62 Pp. (ER 113G)

398 *Leaching Studies of Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans From Municipal Incinerator Flyash.* Karasek, F.W., Tong, H.Y. and Reuel, G.J., University of Waterloo. 49 Pp. (ER 126G)

399 *Analysis of Trace Organic Constituents in Inorganic Chemicals Using Gas Chromatography/Mass Spectrometry.* Karasek, F.W. and Thompson, T.S., University of Waterloo. 170 Pp. (ER 127G)

400 *Synthesis of Chlorinated Azobenzene.* Bunce, N.J., University of Waterloo. 14 Pp. (ER 146G)

401 *Electrothermal Vaporization and Gas Chromatography for Sample Introduction into a Plasma for Plasma Source Mass Spectrometry.* Van Loon J.C. *et al.*, University of Toronto. 1988. 28 Pp. (ER 207G)

402 *Regioselective Synthesis of Isomerically Pure Phenanthrene and Phenanthridine PAH.* Fu, J.M., Siddiqui, A. and Snieckus, V., University of Waterloo. 17 Pp. (ER 208G)

403 *Development of the GC/MED System as a NON-GC/MS Screening Technique for Hazardous Wastes.* Jackson, R., Barringer Magenta Ltd. 1988. 17 Pp. (ER 211C)

404 *The Development of a Sample Preparation Method.* Kilner, T., Ryerson Polytechnical Institute. 1987. 51 Pp. (ER 225C)

405 *Development of a Relatively Inexpensive but Reliable Ultrasonic Nebulizer System for Liquid Sample Introduction into ICP's and Flames.* Petrucci, J. and Van Loon, J.C., University of Toronto. 44 Pp. (ER 230G)

406 *Klebsilla pheumoniae Membrane Filtration Procedure.* Seyfried, P.L. and Desjardins, R.M., University of Toronto. 1988. 51 Pp. (ER 276G)

407 *AZA-Polycyclic Aromatic Hydrocarbons: A Review of the Literature.* Cullen, K.T., University of Waterloo. 1988. 139 Pp. (ER 304G)

408 *Detection and Quantification of Herbicide Residues in the Environment Using Immunochemical Techniques.* Hall, J.C., University of Guelph. 1989. (ER 328G)

409 *Refinement and Testing of a Preconcentration Sampler for Dioxins in Water.* Brownlee, L.J. *et al.*, Carleton University. 105 Pp. (ER 329G)

410 *Retractable Composite Adsorbents for Environmental Clean-Up.* Gillies B., Ecoplastics Limited. 1989. 120 Pp. (ER 375C)

411 *Clorinated and Non-Chlorinated Organics Storage Studies.* Neaves, W.M. and Fong, B., Enviroclean. 1989. 33 Pp. (ER 412C)

Environmental Socio-Economics

412 *The Transport of Liquid Industrial Waste in Ontario.* Donner, A., ARA Consultants. 1987. 71 Pp. (ER 293C)

413 *The Psychosocial Impacts of Exposure to Environmental Contaminants in Ontario.* Taylor, S.M., McMaster University. 1989. 256 Pp. (ER 315G)

414 *The Effects of Forestry Operations upon the Environment of Ontario.* Federation of Ontario Naturalists. 1986. 536 Pp. (ER 365C)

Miscellaneous

415 *The Sterile Insect Release Method for Control of the Onion Maggot (Delia antiqua).* McEwen, F.L. *et al.*, University of Guelph. 1983. 19 Pp. (ER 42G)

416 *The Ontario Atlas of Breeding Birds — A Guide for Participants.* Eagles, P., and Sharp, M., University of Waterloo. 1981. 20 Pp. (ER 51G)

417 *Biotechnology Policy Development, Vol.* 1. MacDonald, Canadian Environmental Law Research Foundation. 1988. 40 Pp. (ER 265C)

418 *Biotechnology Policy Development, Vol.* 2. MacDonald, Canadian Environmental Law Research Foundation. 1988. 52 Pp. (ER 265C)

Excellence in Research Awards

Environment Ontario recognizes excellence in external environmental research annually through awards to selected principal investigators of ministry-funded projects and students. A third category, staff achievement, recognizes outstanding research contributions by ministry staff.

Principal investigator awards

Ministry of the Environment Excellence in Research Awards are granted annually to selected external researchers who have conducted projects supported by the Environmental Research Program. Awards may be made in each of the six research areas supported by the Environmental Research Program, and also for research relating to pesticides. Winners receive a $1 000 award and a citation. The investigator's department or company also receives a plaque in recognition of its encouragement and support.

1990 Awards

Air Quality Research

Dr. Han-Ru Cho
Department of Physics
University of Toronto

Title: *Physical and Chemical Processes Affecting Long-Range Transport of Air Pollutants and Acid Rain*

Reason for Award: Using the Eulerian model approach, this project contributed to a greater understanding of pollutant transport and transformation during cyclonic storms in the north-eastern United States.

Water Quality Research

Dr. George Ozburn
Dr. Lynn McCarthy (joint award)
Department of Biology
Lakehead University

Title: *Quantitative Structure — Activity Relationships for Organic Compounds and Their Mixtures*

Reason for Award: Using a kinetic modelling approach, a means of addressing the links between contaminant body burden in fish and toxic effects was developed. The research also established methods of assessing the toxicity of mixtures of pollutants.

Liquid and Solid Waste Research

Dr. Grahame Farquhar
Department of Civil Engineering
University of Waterloo

Title: *Behaviour, Detection and Control of Hazardous Immiscible Liquid Movement in Soil*

Reason for Award: Project resulted in significant advances in the understanding of the movement of hazardous immiscible liquids such as kerosene and hydraulic oil following a spill.

Analytical Methods and Instrument Development

Dr. William Craig
Paracel Laboratories Ltd.
Ottawa

Title: *Solid Phase Extraction of PAHs From Drinking Water and Analysis of Chlorophenols and Phenoxy Herbicides in Water*

Reason for Award: Development of this

methodology for the analysis of chlorophenol/phenoxyacid herbicides has dramatically reduced the labour involved in sample preparation and resulted in improved speed and precision of analysis. The techniques are already in use or being adopted by various ministry laboratories.

Student Awards

Excellence in Research (Student) Awards are accorded annually to outstanding students participating in environmental research. Eligible categories are as for the principal investigator awards. Winners receive a $1 000 award and a citation. Their departments also receive plaques in acknowledgment of their encouragement and support.

1990 Awards

Air Quality Research

Ms. Beverly Ross
Department of Chemistry
University of Windsor

Project Title: *Mechanistic Studies of Reactions Leading to Formation and Emission of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans During Waste Incineration.*

Reason for Award: Project contributed to a greater understanding of the formation reactions of these toxic organic pollutants. This knowledge will lead to methodologies and actions that will reduce the levels of these air pollutants being emitted from incinerators and other combustion processes.

Water Quality Research

Dr. Miriam Diamond
Department of Chemical Engineering and Applied Chemistry
University of Toronto

Project Title: *Modelling the Fate and Transport of Arsenic and Other Inorganic Chemicals in Lakes*

Reason for Award: Data resulting from a study of arsenic dynamics between water and bottom sediments in a contaminated lake system (Moira Lake) was used to develop a novel modelling and interpretation system. This approach will be widely applicable to studies of the dynamics of a range of chemicals in other lakes.

Liquid and Solid Waste Research

Dr. Jeanne Percival
Geography Department
Carleton University

Project Title: *Uranium-Clay association at Cigar Lake, Saskatchewan*

Reason for Award: As a natural analog for the deep burial disposal method for high-level waste disposal, the project studied the association of radioactive uranium with clays, iron oxides and other minerals at this site. The results of this work will have direct application to the selection of buffer/backfill for a waste repository.

Pesticides Related Research

Dr. Francisca Campos
Department of Biology
University of Ottawa

Project Title: *Toxicity and Toxicokinetics of DMBOA in Corn Borer*

Reason for Award: Project determined the mechanism of natural resistance in corn to insects. This information will be useful in reducing pesticide use.

Staff Achievement Awards

Staff Achievement in Research Awards are presented annually to Environment Ontario staff in six areas in recognition of their accomplishments in environmental research, project management or outstanding liaison activities. Recipients receive a Citation of Merit.

1990 Awards

Air Quality Research

Mr. Gary DeBrou
Coordinator, Mobile Monitoring Centre
Atmospheric Research and Special Programs Section
Air Resources Branch

Contribution to: the development of ambient air monitoring techniques using mobile mass spectrometry.

Water Quality Research

Mr. Ken Nicholls
Supervisor, Aquatic Plants Unit
Limnology Section
Water Resources Branch

Contribution to: the understanding of the effects of whole lake manipulations and algae taxonomy and ecology.

Liquid and Solid Waste Research

Dr. Charles Bostock
Engineer, Landfill Technology Development Unit
Technology and Site Assessment Section
Waste Management Branch

Contribution to: effective liaison between the Ministry and external researchers on landfill related waste management projects.

Analytical Methods and Instrument Development

Mr. David Boomer
Coordinator, Emission Spectroscopy/Waters Unit
Inorganic Trace Contaminants Section
Laboratory Services Branch

Contribution to: the development of advanced multi-elemental determination of trace metals in drinking water.

Socio-Economics Research

Dr. Jack Donnan
Project Coordinator
Socio-Economics Section
Fiscal Planning and Economic Analysis Branch

Contribution to: the development and implementation of major Ministry economic programs in support of socio-economic research, APIOS, MISA and the quantification of environmental costs and benefits.

Pesticides Related Research

Dr. Ron Harris
Pesticides Advisory Committee
(Chairman, Department of Environmental Biology, University of Guelph)

Contribution to: the advancement of pesticides related research particularly in the area of the effectiveness, behaviour and mobility of insecticides in soils.

Special Staff Achievement Award

Dr. Mike Moselhy
Senior Research Advisor
Research and Technology Branch

In recognition of his long-time dedication to the Environmental Research Program and the annual Technology Transfer Conference.

Environmental Technologies Program

The Environmental Technologies Program (ETP) was begun in 1990 to help develop new technologies to overcome environmentally damaging practices. The ETP focusses on the latter stages of the technology innovation process, the development, refinement and commercialization of the product or process.

The ETP financially supports the technological innovations needed by Ontario's industries to adhere to environmental protection initiatives. The Municipal Industrial Strategy for Abatement (MISA) and the Ontario Waste Abatement Strategy are two such initiatives. The ETP also helps to create technologies which can be marketed internationally.

Developmental projects conducted under the ETP fall into seven categories:

- ❑ waste management
- ❑ water and sewage treatment
- ❑ 3R's technologies
- ❑ analytical instrumentation
- ❑ tire technologies
- ❑ air pollution control
- ❑ socio-economic analysis

Management of the ETP rests with the Environmental Technologies Advisory Committee (ETAC). Among its responsibilities are the definition of technology priorities, and the recommendation of projects for funding.

Technology Coordinators in each of the above areas also play an important and ongoing role in the review of applications and administration of projects.

Funding

To be eligible for funding, recipients must operate or reside in Ontario. A wide range of organizations qualify, including Canadian corporations, subsidiaries of foreign owned firms, universities and municipalities.

Typical ventures eligible for funding include:

- ❑ research leading to the development of an innovative process or product
- ❑ equipment prototype development and testing
- ❑ pilot-scale equipment refinement and adaptation
- ❑ field trials and demonstration of innovative technologies to determine system performance, reliability and cost effectiveness
- ❑ initial demonstration of foreign technologies to determine their suitability to Ontario conditions

Only developmental or demonstration aspects of the technology are eligible for support. Costs associated with commercialization, full-scale production and marketing are not supported. Generally, funding for a project does not exceed 50 per cent of the total cost to a maximum of $500,000 per year.

Preference is normally given to technologies that prevent or reduce pollution at the source, rather than at the end of the pipe or stack. Those which assist organizations in meeting regulatory requirements, such as MISA, are particularly favoured.

The ETP requires a comprehensive application, review, monitoring and reporting process.

Application Process

Applications for ETP funding are normally considered twice a year. Submissions must include detailed technical and commercial objectives, a budget, anticipated goals and a commercialization plan. The contribution of the project to ministry technology and regulatory needs must be clearly defined as must the potential value to the environment.

At least three reviewers from various provincial ministeries and such agencies as the Ontario Development Corporation give technical and financial evaluations of each proposal. Reviews and any subsequent recommendations of the ETAC are based on broad selection criteria including:

- ❑ net contribution to environmental protection
- ❑ effectiveness in addressing ministry technical, policy and regulatory requirements
- ❑ technical excellence
- ❑ degree of innovation
- ❑ commercialization potential locally and internationally
- ❑ industrial and economic benefits
- ❑ financial and management capability of the applicant

The Contract

With ETAC recommendation for approval, and senior management concurrence, the ministry negotiates a contract with the proponent. This covers the two phases of each project, the development and then the commercialization of the product or system. The contract contains a marketing and sales program, including the milestones or goals to be achieved during commercialization, which typically takes three to four years after development.

A ministry Liaison Officer helps to set a timetable for the completion of significant stages. With possible assistance from an external expert or ministry technical committee, the Liaison Officer then becomes responsible for monitoring progress toward technical, financial, and commercial goals.

The proponent of each project must submit progress reports, including expenditure details, every six months or upon reaching each major goal. Although there are provisions for payment of funds prior to project initiation, continued payments are generally made only upon achievement of previously negotiated goals.

Upon completion of the developmental phase, a report must be submitted which discusses major research and development components, and provides an updated commercialization plan. As well, the net environmental, economic, and industrial benefits that will accrue to the province must be defined. Typically, this would include expected reductions in specified emissions, or anticipated levels of reduction, reuse and recycling.

After the commercialization phase, a final report must summarize the production levels and sales achieved during commercialization, as well as the actual net environmental, economic and industrial benefits achieved. The reasons for any discrepancies between forecast and actual levels or benefits must be discussed.

Environmental Technologies Advisory Committee Members

Mrs Helle Tosine (Chair)
Director, Research and Technology Branch

Mr. Richard Abbot
ORTECH International

Mr. Don Bartkiw
Director (Acting),
Waste Management Branch

Mr. John Bray
Director,
Approvals Branch
Dr. Richard Findlay
Director,

The Ontario Round Table on Environment and Economy

Mr. John Hoicka
Senior Policy Advisor,
Primary Sector and Manufacturing,
Ministry of Treasury and Economics

Dr. Bruce Jank
Director,
Wastewater Technology Centre,
Environment Canada

Ms. Tammy Lomas
Environmental Technologies Analyst,
Research and Technology Branch
(position currently occupied by Mr. Matt Uza)

Ms. Jan Lam
Assistant Deputy Minister,
Energy Programs and Technology Division,
Ministry of Energy

Mr. James Orgill
Innovation Ontario Corporation

Mr. Wayne Scott
Director, Northwest Region

Mr. Doug Vallery
Manager (Acting),
Environmental Technologies Program,
Research and Technology Branch

Dr. Martin Walmsley
Director,
Premiers's Council Technology Transfer Fund,
Ministry of Industry, Trade and Technology

Ms. Diana Wickham
Manager,
Domestic Industry Support Branch,
Ministry of Industry, Trade and Technology

Ministry of the Environment personnel unless otherwise designated.

Technology Review Coordinators

Credit for the success of the ETP in the short time it has been operating is due partly to the significant role played by the Technology Review Coordinators. The coordinator's function is to oversee the detailed technical review of all proposals in their particular technology area, and to present summaries of this to the Environmental Technologies Committee for dicussion. They also assist in the on-going support of funded technology projects either directly, or in cooperation with project Liaison Officers or Steering Committees.

The following lists the Technology Review Coordinators for each of the technology areas.

Waste Management

Mr. Mel Fielding

Mr. Fielding is Coordinator of Technology Transfer for the Waste Management Branch. In addition to his role in both the Environmental Research and Environmental Technologies Program, he coordinates branch reviews and comments for environmental assessments and ministry policies and guidelines in general.

Water and Sewage Treatment

Mr. Ron Hunsinger

As Supervisor of the Drinking Water Technology Assessment Unit, Water Resources Branch, Mr. Hunsinger oversees the evaluation and refinement of drinking water treatment technologies by coordinating advisory and monitoring services. Mr. Hunsinger facilitates technology transfer through liaison with associations such as the American Water Works Association, coordination of technology seminars and special projects such as co-authoring a book on Water Utility Computer Instrumentation.

3R's and Tire Technologies

Mr. Ron Neilson

In the Data and Support Section of the Waste Reduction office, Mr. Nielson is involved with the development of information collection systems and calculation methodologies for measuring and monitoring the wastestream. In this capacity, Mr. Neilson, a Liaison Officer, works closely with many outside organizations and municipal departments, developing the lines of communication through which information is relayed.

Review coordination of the tire technologies sector has recently become the responsibility of Mr. Neal Ahlberg, Manager of the Technology Development Section of the ministry's Waste Reduction Office.

Analytical Instrumentation

Mr. David Boomer

Mr. Boomer is Coordinator of the Emission Spectroscopy/Waters Unit in the Inorganic Trace Contaminants Section of the Laboratory Services Branch. This group uses sophisticated analytical equipment to develop methods for and analyze a wide variety of environmental samples. He is also involved with technology transfer by serving on various ministry committees, publishing scientific papers and by serving as adjunct professor or adviser to three local universities.

Air Pollution Control

Ms. Janine Zend

As Manager, Emission Technology and Regulation Development Section, Ms. Zend oversees the assessment of air pollution control technologies and source emission tests, and the development of air quality strategies, policies, regulations and guidelines for both stationary sources and vehicles.

Socio-Economic Analysis

Ms. Orna Salamon

Ms. Salamon is a Project Coordinator in the Socio-Economics section of the Fiscal Planning and Economic Analysis Branch. Ms. Salamon has conducted many studies related to the valuation of environmental remediation efforts and is currently involved in a variety of initiatives including waste management and 3R's. Among her interests are the design and application of economic instruments to achieve provincial environmental objectives.

Environmental Technologies Program Projects — 1990/91

The Environmental Technologies Program supported 9 projects during the year in four of the seven technology areas. A further 11 projects were approved and contractual agreement reached for initiation in the 1991-92 year. These projects are designated with an asterisk. A total of $5 611 496 was committed. No projects have been approved to date in the Tire Technologies, Air Pollution Control, or Socio-Economic Analysis categories.

Projects in Progress During 1990/91

Waste Management

419 Demonstration of Vitrokele™ Technology to Recycle Cyanides and Metals at Gold Plants

Jasmetech Metal Technologies Inc.
D. Kidby

67 Watson Rd.
Guelph, ON
N1H 6H8

ET 010

Construction and operation of a pilot plant, at sites in Hope Brook, Nfld. and Bell Creek, Ont., to demonstrate a technically robust and economically attractive process for producing environmentally acceptable effluent

from gold mills. Vitrokele™, a family of synthetic adsorbents, capture cyanide for recycling as well as significant quantities of metals such as copper in what is termed the Cyanosave process. Potentially, this technology could result in a pollution abatement process which recovers all capital expenditure and produces an ongoing operating profit.

Initiated: 12.90
Total Projected Contribution: $406 000

---

420 Electrolytic Recovery of Zinc from Galvanized Steel

Metal Recovery Industries Inc.
A.W. Kellner

670 Strathearne Ave. N.
Hamilton, ON
L8H 7N7

ET 033

Development of an alkaline zinc electrowinning process which can be used in conjunction with an electrochemical degalvanizing process to produce a high quality zinc product. This project involves the optimization of cell operating parameters and the design and construction of a prototype zinc harvesting and purification system. Successful development would afford the opportunity to recover much of the 700 000 kg of zinc waste now generated annually in galvanized scrap remelting in Canada.

Initiated: 3.91
Total Projected Contribution: $120 000

---

421 Development of Innovative Electrochemical Membrane Technology to Permit Source Recovery and Recycling of Waste Acids and Etchants

Prosep Technologies Inc.
C.J. Brown

Unit 7, 817 Brock Rd. S.
Pickering, ON
L1W 3L9

ET 057

Construction and operation of a pilot plant incorporating electrochemical membrane and ion exchange technology to recover and recycle spent pickling liquors, dilute acid waste streams and spent metal etchants from the metal finishing industry. The pilot scale data will then be used to design and manufacture a full-scale plant which will operate for six months. This process would eliminate the production of hazardous metal hydroxide sludges and salt discharges produced during conventional neutralization of the above waste streams.

Initiated: 1.91
Total Projected Contribution: $732 600

---

422 Treatment of Fluids Containing Organic Contaminants Using a Two Stage Adsorption Oxidation Process

Trojan Technologies Inc.
W.L. Cairns

845 Consortium Ct.
London, ON
N6E 2S8

ET 076

Development of technology for the treatment of organic contaminants in fluids using a two stage adsorption-oxidation process. This system could be used for the treatment of off-gases, ground water, potable water and wastewater; or potentially be retrofitted to other adsorption technologies such as activated carbon filters for the regeneration of the adsorbent.

Initiated: 1.91
Total Projected Contribution: $314 445

---

423 Micro-computer Based Expert System for Mine/Mill Effluent Treatment Plant Design (Gold Industry Case)*

Wastewater Technology Centre
A. Zaidi

P.O. Box 5050
Burlington, ON
L7R 4A6

ET 127

Formulation of a computer-based system which can be used to design and tailor the most cost-effective effluent treatment system for cyanide/metals/toxicity removal for any given gold mine/mill. It will be able to generate a comprehensive report containing all relevant information on process design and cost of the selected system. The initial system will be designed for the Ontario gold mining industry with capabilities for expansion into other industrial sectors.

Initiated: 8.91
Total Projected Contribution: $284 750

---

424 Extension and Finalization of the LANDIS Expert System*

Dearborn Chemical Company Ltd.
D.N. Young

P.O. Box 3060, Station A
Mississauga, ON
L5T 3T5

ET 130

Extension and final development of the LANDIS (LANd

DISposal) program, a computerized solid waste landfill disposal assessment system, to a form relevant to Canadian situations and suitable for distribution. The LANDIS approach will be the first regulatory-oriented methodology to address specific site disposal conditions and permit "what if" scenarios to be evaluated cost-effectively using expert system and database technology.

Initiated: 4.91
Total Projected Contribution: $200 000

Water and Sewage Treatment

425 Modular Drinking Water Pilot Plant for the 1990's

P.M. Huck

Department of Civil Engineering
University of Waterloo
Waterloo, ON
N2L 3G1

ET 006

Design, construction, and process optimization for a state of the art water treatment pilot plant. This refined modular design could be used by utilities and consultants to investigate ways of reducing levels of disinfection by-products such as trihalomethanes, and improving the removal of various organic contaminants and particulates from drinking water. Such a prototype would be of widespread interest with the impending need in the 1990's for the upgrading of surface water treatment plants.

Initiated: 10.90
Total Projected Contribution: $785 900

426 Development of Membrane Technology for Drinking Water Production: Treatment of Coloured Waters

ZENON Environmental Inc.
R.P. Canning

845 Harrington Ct.
Burlington, ON
L7N 3P3

ET 007

Evaluation of the potential of nanofiltration membrane technology for the removal of the organic compounds that cause coloured drinking water. Apart from aesthetic concern, these organic substances react with chlorine during conventional disinfection processes to form harmful products such as trihalomethanes. Once proven on a laboratory scale, this technology will be incorporated into an on site demonstration pilot plant.

Initiated: 2.91
Total Projected Contribution: $160 000

427 Further Development of the Rayox Enhanced Oxidation Product

Solarchem Enterprises Inc.
A. Buckley

Unit 5, 40 West Wilmot St.
Richmond Hill, ON
L4B 1H8

ET 024

Improvement of the core technologies of this system for the remediation of contaminated groundwater and drinking water, and industrial wastewater treatments. This cost-effective technology would facilitate achievement of the MISA goal of virtual elimination of organic contaminants from these sources with no secondary disposal requirements.

Initiated: 2.91
Total Projected Contribution: $688 000

428 Hard Metal, High Efficiency Sludge Handling Pump*

Hayward Gordon Ltd.
J. Hayward

7505 Bath Rd.
Mississauga, ON
L4T 1L3

ET 036A

Evaluation of 11 models of a screw impeller centrifugal pump for use in the handling of sewage and sludge in municipal and industrial wastewater treatment plants. This involves the design, equipment prototype development, testing and full-scale field trials of the models. These efficient and reliable pumps would reduce energy requirements and, in many solids handling services, would replace less efficient pump designs. This improved sludge handling would contribute to the more efficient and economic operation of wastewater treatment plants.

Initiated: 9.91
Total Projected Contribution: $95 000

429 Catalysed Reductive Degradation of Halogenated Organic Compounds

R.W. Gillham

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ET 074

Development of a cost-effective alternative to processes such as activated carbon adsorption or aeration for removing halogenated organic compounds from water. Through extensive laboratory testing and field investigations, a system will be designed and tested for use in applications such as remediation of existing zones of groundwater contamination, treatment of wastewater and removal of trihalomethanes from chlorinated municipal water supplies.

Initiated: 3.91
Total Projected Contribution: $227 000

430 Development of Continuous Preparation of Activated Silica*

National Silicates Ltd.
S. Gibson

429 Kipling Ave.
Toronto, ON
M8V 3S7

ET 132

Development of a process for the continuous preparation of activated silica, an effective inorganic coagulant aid. Activated silica is produced through the polymerization of sodium silicate with a variety of activating agents. Successful development of an on-site production process, that is practical and economical, would enable the manufacture of an alternative product to organic and inorganic polyelectrolytes for use in potable, sewage and industrial wastewater treatment. Smaller institutions as well as larger utilities can expect practical design systems. Activated silica has been demonstrated as an effective coagulant aid in the reduction of total phosphorus discharges from sewage treatment plants and other industrial institutions. Organic polymers may have carcinogenic or other health related concerns, similar to those experienced in Europe and the United States.

Initiated: 8.91
Total Projected Contribution: $194 000

431 Wastewater Aerator Prototype*

Aqua Aeration Systems Inc.
A.S. Jankowski

3321 Valmarie Ave.
Misissauga, ON
L5C 2A4

ET 135

Evaluation under field conditions of a full-scale prototype for the aeration of waste water. The aerator functions by drawing in and mixing atmospheric air from above the liquid. The efficiency of this design is such that it performs its function without the need for a supplementary external supply of air. This aerator would have the capability to simultaneously increase the capacity of treatment facilities, and reduce their operating costs through reduced energy and maintenance requirements.

Initiated: 5.91
Total Projected Contribution: $95 000

432 Development of Sealable Join Sheet Pile Cutoff Walls for Groundwater Remediation*

J. Cherry

Waterloo Centre for Groundwater Research
University of Waterloo
Waterloo, ON
N2L 3G1

ET 143

Design and production of modified steel sheet pile sections and selection of sealants for use in the construction of low permeability cutoff walls. These walls could be used throughout North America in the remediation of existing contaminated groundwaters or for preventing or minimizing the spread of contamination from existing sources into groundwater. The effectiveness of this technology for these purposes will be demonstrated under various field conditions.

Initiated: 5.91
Total Projected Contribution: $152 000

433 Demonstration and Full-Scale Testing of a New Thermal Chemical Reduction Process for Remediation of Hamilton Harbour Sediments*

EcoLogic International Inc.
D.J. Hallet

143 Dennis St.
Rockwood, ON
N0B 2K0

ET 153

An examination of the operational capability and regulatory compliance of a new thermo-chemical reduction process for the decontamination of Hamilton Harbour sediments. This system could eliminate toxic polyaromatic hydrocarbons and other organic carbons from the sediments allowing the remaining solids to be safely disposed of in a regular non-hazardous waste municipal landfill.

Initiated: 4.91
Total Projected Contribution: $311 000

3R's Technologies

434 Development of a Process which will Reclaim Scrap and Produce New Products for Interior and Exterior Architectural Applications

Plastiglas Industries Ltd.
G. D'Aurelio

403 Clements Rd.
Ajax, ON
L1S 6N3

ET 029

Development of methodology for the recovery of fibres from scrap fibreglass and their incorporation into new products such as building material or furniture. Fibreglass reinforced products cannot presently be recycled. When fully operational, the company would be able to recover much of their scrap and that from other fibreglass manufacturers, diverting a significant quantity of material from landfill sites.

Initiated: 2.91
Total Projected Contribution: $67 071

435 Development of Mercury Free Reusable Alkaline Manganese Dioxide (RAM) Consumer Batteries*

Battery Technologies Inc.
K. Tomantschger

2480 Dunwin Dr.
Mississauga, ON
L5L 1J9

ET 048

Acceleration of the development of the mercury free RAM battery technology for use in small format consumer battery sizes (AAA, AA, C, D). Emphasis is on the further development and refinement of the technology to produce a rechargeable alkaline battery which is free of mercury, and with performance and cost comparable to existing single use alkaline batteries. Use of such batteries would greatly reduce the estimated 13 tonnes of mercury disposed of annually into the Canadian environment through the disposal of small format batteries into landfill sites and incinerators.

Initiated: 4.91
Total Projected Contribution: $247 500

436 RMDC Roofing Shingles Recycling*

Roofing Materials Disposal Company Ltd.
K.M. Beare

247 Elmhurst Cres.
Burlington, ON
L7L 2A5

ET 052

Development of a small portable processing plant for the recycling of roofing shingle waste. Based on an auger extruder, the plant will mechanically disintegrate roofing waste and homogenize it into a bituminous raw material. This could then be marketed as a roading material or formed into products such as paving stones. Successful introduction of this technology could divert as much as 500 000 tonnes of waste from landfill each year in Canada.

Initiated: 5.91
Total Projected Contribution: $90 000

437 Deinking of Wastepaper by High Pressure Steam Treatment for Paper Reuse*

Stake Technology Ltd.
E. Yu

2838 Highway 7
Norval, ON
L0P 1K0

ET 068

Determination of the technical and economic feasibility of continuous steam-explosion treatment in the deinking of selected wastepapers for paper recycling and reuse. After the optimization of the process, operation of a pilot plant will allow comparison against conventional technology. A plant using this technology would facilitate enhanced ink removal from paper fibres, reduce consumption of deinking chemicals and

energy, and enable deinking of certain wastepaper types currently not recyclable.

Initiated: 8.91
Total Projected Contribution: $192 250

Analytical Instrumentation

438 Development of a Nitrogen-Specific GC/ Detector for Measurement of Atmospheric Nitrates*

Unisearch Inc.
J. Drummond

222 Snidercroft Rd.
Concord, ON
L4K 1B5

ET 066

Development, construction and evaluation of a market-ready nitrogen specific gas chromatography detector that can be applied to measure a variety of atmospheric pollutants that are intimately linked to oxidant formation in the atmosphere. The instrument could also be applied to the measurement of a variety of organo-nitrogen species such as carcinogenic nitrated PAHs in the atmosphere and nitrosamines in foods.

Initiated: 6.91
Total Projected Contribution: $248 980

Miscellaneous Grants

The objective of the Miscellaneous Grants (MG) program is to provide financial assistance for environmental education and awareness projects that support the mandate of the Ministry of the Environment. In the 1990/91 year, 118 proposals were received. A total of $898 604 was awarded to 70 projects.

Through its funding of a wide range of environmental education and awareness projects, the MG program increases the public's awareness of environmental issues, and encourages an environmentally acceptable lifestyle for the people of Ontario.

Eligibility

The MG program provides financial assistance to a broad spectrum of public awareness activities. Conferences, workshops and other forums specifically related to the ministry's mandate qualify, as do many types of publications such as newsletters and factsheets. Theatrical presentations on environmental themes are also entitled to funding.

A wide variety of organizations qualify for funding from the MG program including non-profit incorporated organizations or associations, community and interest groups, and schools, universities and municipalities.

Only certain types of expenditure are eligible including the costs of document preparation, printing and distribution, equipment rental, and newspaper and radio publicity. Costs such as salaries, overhead and capital expenditures do not qualify.

The MG Process

Applications are received and reviewed by a committee comprised of ministry staff representing the various divisions, branches and regional offices. Preference is given to projects that;

- have a clear environmental and educational purpose
- are geared toward pollution prevention as opposed to pollution control
- are unique
- are most cost effective and likely to succeed
- support the mandate of the ministry
- indicate support from a broad range of agencies

A final report is required within three months of project completion. This includes a detailed project summary, a statement of benefits realized and a detailed budget.

Note: The Miscellaneous Grants program was renamed the Environmental Education and Awareness Program in August, 1991. Its coordination remains the responsibility of the Research and Technology Branch.

Projects in Progress During 1990/91

439 Conference on "Waste Management and Sustainable Development," Fall, 1990

Sault College of Applied Arts and Technology

P.O. Box 60
Sault Ste. Marie, ON
P6A 5L3

EC 9039

Conference focussed on two key issues. The first was the question of sustainable development and its importance to the northern environment. Secondly, the use of innovative technologies for waste management was addressed. The forum was jointly organized by Sault College and the Cost-Effective Technologies Environment Committee for Northern Ontario (CETEC-North). Conference proceedings are now available.

Award: **$10 000**

440 Engineering Week, March 4-11, 1990

Engineering Week '90 Steering Committee

Suite 1003, 192 Jarvis St.
Toronto, ON
M5B 2J9

EC 9043

A series of events including public lectures, seminars and forums to raise public awareness of the importance of engineering, science and technology. A one-hour film on sustainable development entitled "The Environment — Our Common Future" was also produced. This was broadcast on television to an estimated audience of 4 million viewers and is now available on request.

Award: **$3 400**

441 Communities and the Environment Conference, June 8-10, 1990

United Nations Association in Canada, Toronto Branch

Suite 116, 2 College St.
Toronto, ON
M5G 1K3

EC 9049

National conference to develop a plan of action to promote public awareness of, and participation in, environmental protection. This was in preparation for the 1992 World Conference in Brazil on Environment and Development. Agenda topics included sustainable development, the conserver society, environmental degradation and "sustainable cities."

Award: **$8 500**

442 Elder's Conference on the Environment, Spring 1990

Chiefs of Ontario, Toronto Office

2nd Floor, 22 College St.
Toronto, ON
M5G 1K2

EC 9052

Conference set down the recommendations of the Elders for an appropriate First Nations of Ontario policy on the environment based on traditional philosophies and spiritual values. Topics of discussion included economic resource development, health of society and the freedom from fear of pollution-generated diseases.

Award: **$2 500**

443 Provincial Workshop on Water Quality Issues, June 5, 1990

Ontario Public Health Association

Suite 202, 468 Queen St. E.
Toronto, ON
M5A 1T7

EC 9053

This forum addressed the key water quality issues facing Ontario in the 1990's. Topics of discussion included groundwater contamination and protection, the ministry's daily water surveillance program, and the results of recent tests on drinking water purification and treatment devices.

Award: **$1 500**

444 Conference on the "International Environment," November 13, 1990

Worldwise International Awareness Centre

P.O. Box 296
St. Catharines, ON
L2R 6T7

EC 9054

Conference heightened environmental awareness of high school students in the Niagara Region through discussions on sustainable development and food production, pollution, waste management, global warming, rainforests and deforestation. Participants

received a free information package. This included fact sheets, resource lists and suggestions for an environmentally acceptable lifestyle.

Award: **$4 600**

---

445 Conference on "Environmental Sciences Education Curricula," Fall, 1990

College of Physical and Engineering Science
University of Guelph

Guelph, ON
N1G 2W1

EC 9055

Focussed on current and future educational needs of university undergraduates interested in pursuing careers in environmental sciences and engineering. Input was solicited from industry and government agencies, including the ministry, as to the necessary knowledge and skills that students must acquire to meet current and future requirements.

Award: **$14 500**

---

446 "Winds of Hope" Conference, September 7-9, 1990

Chippewas of Nawash First Nation, Wiarton Project North "Circle"

P.O. Box 705
Wiarton, ON
NOH 2TO

EC 9057

Public forum examining peace, justice and environmental issues from a traditional native perspective. This colloquium involved native and non-native groups and included First Nation Elders, environmentalists and members of the scientific community. Attendance at the symposium exceeded 500.

Award: **$13 400**

---

447 "Preview 2000" Sixth Canadian Construction Congress, December 5-7, 1990

Canadian Construction Research Board

National Research Council of Canada
Building M-20, Montreal Rd.
Ottawa, ON
K1A OR6

EC 9058

Forum examined current economic, demographic and environmental trends affecting the construction industry. The congress also included a trade show of goods and services and a computer exposition. The ministry's financial contribution was to a three-day think-tank to develop plans of action for dealing with Metro Toronto's projected population growth.

Award: **$5 000**

---

448 "The Next Step — A Conference on the Environment," November 16-17, 1990

Labour Council of Metro Toronto and York Region

Suite 407, 15 Gervais Dr.
Don Mills, ON
M3C 1Y8

EC 9059

Conference consisted of workshops on a number of issues including Toronto's port lands, the public's right to a healthy environment, dealing with solid waste and the movement towards an environmentally friendly industrial base. A keynote address by the Hon. Ruth Grier, Minister of the Environment opened the forum. A film on the conference was also produced.

Award: **$2 000**

---

449 Student Conference on the Environment, May, 1991

Parkside High School Environment Club

Parkside Ave.
Dundas, ON.
L9H 2S8

EC 9060

Conference heightened the environmental awareness of high school students in the Hamilton area and developed plans of action for dealing with local environmental concerns. A student environment network was established from this. About 200 delegates attended the event held at McMaster University.

Award: **$2 500**

450 Environmental Fair, October 19-20, 1991

St. David's United Church Environmental Fair Committee

190 Springbank Ave. N.
Woodstock, ON
N4S 7R1

EC 9061

A community event which raised environmental awareness through workshops, displays, a poster contest and a theatrical presentation. Workshop sessions covered a variety of topics including recycling, chemicals and food safety, household hazardous waste, alternate household cleaners, organic gardening and acid rain. Approximately 300 people attended.

Award: **$1 000**

451 Symposium on "The Greater Toronto Area Solid Waste Management Plan," November 15, 1990

Canadian Institute of Energy, Toronto Branch

Suite 1003, 192 Jarvis St.
Toronto, ON
M5B 2J9

PE 9062

Addressed the question of solid waste management through four panels on the following topics: defining the problems and the options, recycling and composting, energy recovery and project implementation. The symposium was augmented by public and industrial exhibits of innovative environmental technologies and services.

Award: **$2 898**

452 "Investing in the Environment" Conference, November 17, 1990

Social Investment Organization

Suite 447, 366 Adelaide St. E.,
Toronto, ON
M5A 3X9

EC 9063

Brought together investors looking for environmentally responsible investment opportunities and businesses able to provide them. Topics addressed included environmental advances by industry, corporate attitudes to environment, alternative investments, screening for green stocks and bonds, venture capital and environmental enterprise, shareholders' responsibilities, and ethical mutual funds and the environment. Conference proceedings available.

Award: **$2 000**

453 "Environment and the Law: Rights and Responsibilities" Conference, March, 1991

Toronto Environmental Alliance

2nd Floor, 456 Spadina Ave.
Toronto, ON
M5T 2G8

EC 9064

Conference helped grassroots environmental groups gain a better understanding of environmental legislation through workshops on The Ontario Environmental Protection Act, The Canadian Environmental Protection Act and The Ontario Environmental Assessment Act.

Award: **$5 250**

454 "Glasnost and the Global Village" Conference, February 19-22, 1991

York University

4700 Keele St.
Downsview, ON
M3J 1P3

EC 9065

Financial contribution towards the global ecology component of this major Canadian-Soviet conference. Issues addressed included the emerging environmental consciousness of the Soviet Union in relation to its transformation to a market-driven economy, the possibility of effecting a joint Canada/USSR environmental legislative agenda for the north and global sustainable development.

Award: **$13 600**

455 "Project Indigenous Restoration" Concert/ Forum, April 21-23, 1991

The Artists' Environment Forum

602 Manning Ave.
Toronto, ON
M6G 2V9

EC 9066

A series of events open to the general public that brought together native people from North and South America on Earth Day, 1991 to share native perspectives on the environment. Topics of discussions included sustainable development, caring for "Mother Earth" by traditional methods and the impact of environmental degradation on the native economy.

Award: **$20 000**

456 "Signs of Hope" Conference on the Environment and Education, April 15, 1990

Muskoka Environmental Educators Association

P.O. Box 974
Bracebridge, ON
P1L 1V2

EC 9068

Conference focussed on local and global environmental issues, in particular, the need for fostering co-operation among many diverse groups. Over 900 delegates attended, the majority from the Muskoka Board of Education. Fifty-six speakers, including Dr. David Suzuki, gave presentations. These were accompanied by displays from over 40 environmental groups and retailers.

Award: **$2 600**

457 1991 MBA Conference: "Business and Our Environment: Responsible Partnerships," February 27 - March 1, 1991

School of Business Administration
University of Western Ontario

London, ON
N6A 3K7

EC 9072

Three-day conference which explored issues critical to sustainable development and the leading role business can play in achieving it. There were some 330 participants, including business students and representatives from scientific, industry and environmental groups.

Award: **$5 000**

458 Great Lakes State of the Environment Report, 1990

Institute for Research on Public Policy

5th Floor, 275 Slater St.
Ottawa, ON
K1P 5H9

PE 9039

A joint report by IRPP and the U.S. Conservation Foundation on the state of the Great Lakes with recommendations on what must be done to make development in the Great Lakes Basin more sustainable. Aimed at the press, concerned public and senior political decision-makers.

Award: **$22 500**

459 Earth Day 1990 Canada (Ontario Office) Project

Earth Day 1990 Canada, Ontario Office

P.O. Box 2022
Peterborough, ON
K9J 7Y4

PE 9055

Support of the Earth Day '90 Ontario office in its provision of information and guidance to individuals, businesses, government agencies and other provincial groups interested in initiating Earth Day/Week projects and events. Communications materials included media kits, brochures, information packages and updates of Earth Day events across Canada.

Award: **$20 000**

460 Establishment of the Environmental Issues Advisory and Research Office

Middlesex-London Health Unit

50 King St.
London, ON
N6A 5L7

PE 9060

Contribution to the establishment of an Environmental Issues Advisory and Research Office in London, Ont. The mandate of this office is to compile information and coordinate and conduct research projects relating to health and the environment in London. Through the Medical Officer of Health, the office reports regularly on the current status of relevant issues and projects.

Award: **$20 000**

461 "Alternatives" Magazine

Faculty of Environmental Studies
University of Waterloo

Waterloo, ON
N2L 3G1

PE 9063

Publication of a four-part series of Alternatives magazine entitled "Asking Hard Questions about Sustainable Development." Published quarterly, Alternatives is a scholarly journal and newsmagazine which provides critical and informed analysis of environmental problems, related social issues and technological developments.

Award: **$9 208**

462 Report: "Water and Waste Water Changes for Ontario: The User Pay Principle"

Association of Municipalities of Ontario

Suite 805, 100 University Ave.
Toronto, ON
M5J 1V6

PE 9064

Publication outlines standard methods for municipal water and wastewater costs accounting, cost allocation and rate setting. Recommendations of the report include; reorganization of water and wastewater services on a utility basis; metering consumption and charging for water according to volume consumed; development of a provincial water strategy which promotes conservation; and the dedication of water revenues to system service and maintenance.

Award: **$15 000**

463 The Backyard Acid Rain Kit (BARK) '90 Program

Public Focus

92 Shaftesbury Ave.
Toronto, ON
M4T 1A5

PE 9065

A bi-national acid rain monitoring project for children aged 9-12 years designed to promote awareness of the environmental impact of acid rain. Approximately 120,000 students participated in the program through monitoring daily weather and pH levels in precipitation.

Award: **$10 000**

464 "Bringing Environmental Concerns and Solutions into the Homes of Ontario."

Environment Probe

225 Brunswick Ave.
Toronto, ON
M5S 2M6

PE 9067

Pilot project designed to raise environmental awareness of the general public through a series of public service radio commentaries on environmental issues and solutions. To date, 19 programs have been produced and broadcast over 30 stations provincewide.

Award: **$20 000**

465 Community Waste Reductions Kits and a guide entitled "Managing Wastes: A Guide to Citizens' Involvement"

Citizens' Clearinghouse on Waste Management

R.R. 2
Cameron, ON
KOM 1G0

PE 9068

Both projects increased the public's understanding of waste management issues and encouraged waste reduction and recycling. Kits included ideas for public displays, posters on hazardous wastes, composting and packaging. Suggestions for dealing with plastic shopping bags, diapers and junk mail were also included.

Award: **$12 000**

466 Pollution Probe's Information Services Program

The Pollution Probe Foundation

12 Madison Ave.
Toronto, ON
M5R 2S1

PE 9070

This service provides up-to-date environmental information to the general public, businesses, government and non-government agencies. This is achieved through the maintenance of a computerized database, various environmental publications and an Environmental Hot-Line. In 1989, this hot-line received over 35,000 requests for information.

Award: **$25 000**

467 Film: Operation Skywatch

Pixie Bigelow Productions

30 Rosedale Heights Dr.
Toronto, ON
M4T 1C3

PE 9073

Development costs of a 60-minute film on "Operation Skywatch", an aerial surveillance program. This operation is made possible by a squadron of volunteer women pilots from the Ninety-Nines Club. They work with members of the ministry's Investigation and Enforcement Branch to identify and document environmental offences. This facilitates the enforcement of the Environmental Protection Act.

Award: **$7 500**

468 Region of Waterloo "State of the Environment Report"

Regional Municipality of Waterloo

Marsland Centre
20 Erb St. W.
Waterloo, ON
N2J 4G7

PE 9075

Comprehensive report addressing major environmental issues of concern in the region. This document assesses present conditions and identifies current trends in the context of sustainable development, social stability and quality of life. It also pinpoints future areas for action by governments, business, community organizations and individuals.

Award: **$7 500**

469 Children's Environmental Festival, November, 1990

Public Focus

Suite 500, 489 College St.
Toronto, ON
M6G 1A5

PE 9076

An annual event intended to raise environmental awareness of elementary school children in Grades 4-6. It consists of theatre performances, presentations, displays, games and other activities on environmental themes. Follow-up activities included composting and recycling projects, and hazardous waste container collection days. Over 35,000 students and adults have attended this event since 1987.

Award: **$25 000**

470 Earth Day Events in Ottawa-Carleton Region, April, 1990

Cultural Survival Earth Day Committee

Suite 420, One Nicholas St.
Ottawa, ON
K1N 7B7

PE 9077

Events on this day heightened environmental awareness of school children and the general public. Activities included a children's environmental festival and eco-fair, a parliament hill rally and a music festival at Rideau Hall.

Award: **$5 000**

471 Global ReLeaf Campaign

Friends of the Earth

Suite 701, 251 Laurier Ave. W.
Ottawa, ON
K1P 5J6

PE 9078

National campaign to inform the public about the causes and effects of global warming. A particular objective is the encouragement of a massive tree planting effort by corporations, utilities, public agencies, community groups and individuals as a means to abate climate change. This campaign will strengthen existing tree-planting activities and programs in Canada and start new local initiatives.

Award: **$20 000**

472 Office of the Canadian Association of United Nations Environment Programme (UNEP-Canada), Opened April 20, 1989

UNEP Canada

Ryerson Polytechnical Institute
350 Victoria St.
Toronto, ON
M5B 2K3

PE 9079

Contribution to the operation of a world-class data and resource centre. This office uses sophisticated computer and electronic communications technology to gather and distribute information on the global environment and sustainable development. It has access to worldwide sources of information, including satellite and space shuttle photography. The centre also organizes seminars and conferences, and maintains an environmental library.

Award: **$25 000**

473 Pollution Probe's Public Education and Outreach Program

The Pollution Probe Foundation

12 Madison Ave.
Toronto, ON
M5R 2S1

PE 9080

This program provides information on environmental issues to the general public through special events such as Earth Day and Environment Week. Conferences, workshops and other exhibitions at universities, schools and shopping malls are also held.

Award: **$13 950**

474 Chemical Literacy Series and Summer Studio for Teachers

Pollution Control Association of Ontario

10 Petch Cres.
Aurora, ON
L4G 5N7

PE 9081

Contribution to allow the association to continue supporting the initiatives of the Society, Environment, and Energy Development Studies Foundation (SEEDS). SEEDS is currently developing three educational packages on chemical literacy and organizes an annual summer workshop for teachers on environmental issues.

Award: $10 000

475 City of Toronto Vehicular Emissions Demonstration, April 23-29, 1990

City of Toronto

City Hall
Toronto, ON
M5H 2N2

PE 9082

Field test of a remote sensor developed at the University of Denver which can measure the CO and CO_2 content of automobile emissions. Concurrently, an automated system which matches the CO/CO_2 data with the licence plate of the emitting vehicle was tested. Emission data indicate that a mere 10% of automobiles account for 50% of auto emissions.

Award: $23 000

476 Canada/U.S. Environmental Inventory Project

City of Niagara Falls

City Hall
4310 Queen St.
Niagara Falls, ON
L2E 6X5

PE 9083

Joint project by the cities of Niagara Falls, NY and Niagara Falls, ON. The intention is to create an inventory of environmental components of the natural and artificial environment using a computerized Geographic Information System format. This inventory will be of considerable benefit in planning projects to enhance and protect the Niagara River environment and for local land use decision making.

Award: $12 000

477 Performance of "The Lorax" at St. Lawrence Centre for the Arts, April 23-29, 1990

St. Lawrence Centre for the Arts

27 Front St. E.
Toronto, ON
M5E 1B4

PE 9084A

A children's participatory play called "The Lorax" based on a poem by Dr. Seuss. The play stresses the importance of the environment and what can be done to improve it. It was performed free of charge to hundreds of school children and their teachers during Earth Week.

Award: $3 000

478 School Tour of "The Lorax," April 30 - June 10, 1990

Toronto Studio Players Theatre School

347-A Carlaw Ave.
Toronto, ON
M4M 2T1

PE 9084B

The environmental message of "The Lorax" was carried to various elementary schools in the Metro region. A teacher's kit was also distributed to participating classes. This included lesson plans, topics of discussion, a copy of the text of the play and other support ideas.

Award: $18 700

479 Detailed Policy and Technical Review of the U.S. Clean Air Act

Canadian Coalition on Acid Rain

Suite 402, 112 St. Clair Ave. W.
Toronto, ON
M4V 2Y3

PE 9086

An expert written review of the impact of those amendments to the U.S. Clean Air Act concerning acid rain. This document not only explains the legislation, but recommends a monitoring plan for use by Ontario government officials. If this monitoring shows that further emission reductions are required from the U.S., further legislative activity in that country may be necessary.

Award: $25 000

480 Seminar on U.S. Clean Air Act, February 4, 1991

Canadian Coalition on Acid Rain

Suite 401, 112 St. Clair Ave. W.
Toronto, ON
M4V 2Y3

PE 9087

This symposium reviewed the U.S. Clean Air Act placing special emphasis on those sections dealing with acid rain and motor vehicle emission controls. The seminar was the first step in a program to monitor the implementation of acid rain legislation in both Canada and the United States, and to oversee the implementation of other sections of the Clean Air Act affecting Canada.

Award: **$18 440**

481 Bicycle Expedition: "A Human Race Towards a Healthy Planet", April 22, 1990 - July 1, 1990

Council of Outdoor Educators of Ontario

1557 Limberlost Rd.
London, ON
N6G 2C9

PE 9088

A trans-Canada bicycle expedition by two Brock University students to raise environmental awareness and encourage students and the general public to work actively to improve the environment. Along the way, the cyclists made over 50 presentations at schools, libraries and churches to approximately 10,000 people. They also distributed free information packages on the environment.

Award: **$4 000**

482 Campaign For A Sustainable Future, based on the "Guideposts for a Sustainable Future Kit"

Bakavi School of Permaculture

P.O. Box 374
Merrickville, ON
KOG 1NO

PE 9089

Public education campaign intended to introduce the concept of sustainable development and how to achieve it to the general public. Another component of this campaign was the establishment of a Citizens Environmental Information Inventory. This consists of a database of all available information relating to the form that sustainable development will take in the future.

Award: **$8 400**

483 Canadian Solar Cup Race, August 25, 1991 - September 1, 1991

Canadian Solar Cup

Bureau 8111-5, 3375 Blvd. Saint-Laurent
Montreal, PQ
H2X 2T7

PE 9090

A solar-powered car race from Toronto to Montreal intended to put into practice the knowledge gained by research centres in the fields of transportation, energy, materials and electronics. The creation of marketing opportunities for these cars was a further objective. The race brought together some 30 vehicles developed by European, North and South American and Asian universities.

Award: **$2 000**

484 "Environment is Everybody's Business: Guide to Practical Action in the Workplace"

Harmony Foundation

19 Oakdale Ave.
Ottawa, ON
K1Y 3S3

PE 9093

This "do-it-yourself" guide is aimed at small businesses, schools and community groups. It provides motivational and instructional strategies to help users develop and implement environmentally friendly practices for their workplaces. Topics covered include energy and water conservation, waste reduction, fine paper recycling and the 3R's.

Award: **$25 000**

485 Report: Suggested Improvements to the Substantive and Procedural Elements of the "Environmental Assessment Process and Intervenor's Workbook"

Credit Valley Preservationists

5372 Drenkelly Ct.
Mississauga, ON
L5M 2H4

PE 9094

The report consists of recommendations for improvements to the environmental assessment process, legislation, and the regulations which are employed to implement the Environmental Assessment Act. Accompanying this is a guide for citizens' organizations involved in the environmental assessment process.

Award: **$23 500**

486 Educational Program to Promote Protection of Oak Ridges Moraine

Save The Oak Ridges Moraine Coalition

P.O. Box 2209, Station B
Richmond Hill, ON
L4E 1A4

PE 9095

Contribution to the collection and coordination of printed resources directed towards the preservation of the integrity of the Oak Ridges Moraine. Outreach activities include presentations to schools and community groups and involvement in trail development.

Award: **$4 000**

487 Documentary Film: "A Cry for the Common Loon"

Front Porch Film and Video

285 Romaine St.
Peterborough, ON
K9J 2C6

PE 9096

Contribution towards production costs of this 60-minute film on the adverse effects of acid rain on the breeding success of the common loon in the Sudbury Basin. The film examines clean-up operations as well as industry's commitment to reduce sulphur dioxide emissions. The work of the Canadian Coalition on Acid Rain and the U.S. Clean Air Bill are also discussed.

Award: **$5 000**

488 University-Level Environmental Course: "The 5000 Days. Environmental Perspectives and Human Choices"

The Institute for Environmental Policy and Stewardship

The Arboretum
University of Guelph
Guelph, ON
N1G 2W1

PE 9100

A topical, hard-hitting distance education course which explores critical issues concerning population, resources and the environment. It is available across Canada for university credit or general interest.

Award: **$25 000**

489 "A Citizen's Handbook To Forest Management Planning In Ontario"

Canadian Parks and Wilderness Society

Suite 1150, 160 Bloor St. E.
Toronto, ON
M4W 1B9

PE 9101

Educational booklet designed to encourage public participation in forest management planning and the Environmental Assessment process. It provides background information, strategic guidelines, and insights into forest management planning for those with little or no experience in the process. The publication is available without charge.

Award: **$2 500**

490 Workshop Production of "The Coming", An Environmental Play

Caravan Stage Company

P.O. Box 228
Wolfe Island, ON
KOH 2Y0

PE 9102

Intended for a general audience, this play looks at environmental degradation and its threat to the continued existence of man. The performance is a combination of theatre, music, opera, dance, sculpture, painting and video. It premiered on Wolfe Island in Summer, 1991 with a provincewide tour planned.

Award: **$2 000**

491 Windsor and Essex Greening Project

London and District Clean Water Alliance

312 Erie St. W.
Windsor, ON
N9A 6B7

PE 9103

Assistance for the educational component of this project involving the dissemination of environmental information to elementary school children. This is achieved through workshops, displays and presentations. The overall objective of the project is to raise environmental awareness of general public and to encourage responsible environmental behaviour by individuals and government.

Award: **$7 500**

492 Production of a Sustainable Development Database

Peterborough Committee on Sustainable Development

106 Murray St.
Peterborough, ON
K9H 2S5

PE 9104

Contribution to the production of a database of existing studies, expertise, and organizaticnal responsibilities with respect to the local environment. This database will help to achieve the ultimate objective of the task force which is to implement sustainable development in the Peterborough area by developing, and encouraging the implementation of, an agenda of priority recommendations.

Award: **$5 000**

493 Radio Course: "The Environment: Issues for Options for Action," April-June, 1991, and September-December, 1991

CJRT-FM Open College

297 Victoria St.
Toronto, ON
M5B 1W1

PE 9108

Designed for both a university audience and the general public, this credit course consists of 24 programs on various environmental issues. Its primary objective is to give listeners a better understanding of environmental problems and how to find solutions. Open College has an estimated 50,000 listeners weekly. The course is now available on audio cassette.

Award: **$20 000**

494 National Visions 2020 Program, 1990-91

Public Focus

Suite 500, 489 College St.
Toronto, ON
M6G 1A5

PE 9109

Program introduced students across Canada to the concept of sustainable development and had them articulate their vision for the year 2020. It is a national version of the very successful Ontario Visions 2020 program which resulted in the publication of Visions 2020 — Ontario's Youth — Ontario's Future. The national program involved over 10,000 senior secondary students.

Award: **$15 000**

495 Distribution of Information on the Proper Handling and Disposal of PCBs

Halton Conservation Authority

Chemical Waste Management Liaison Committee

P.O. Box 1097, Station B
Burlington, ON
L7P 3S9

PE 9110

Contribution towards sourcing and distribution of information to the public on the proper handling and disposal of PCBs. The committee also provided technical information on PCBs at the Smithville mobile PCB facility hearing.

Award: **$3 905**

496 A Report on Household Waste Audits

Citizen's Clearinghouse on Waste Management

R.R. #2
Cameron, ON
KOM 1GO

PE 9118

The report summarizes household waste audit data (in over 50 categories) collected in eight Ontario communities in 1989 and 1990. Comparisons are drawn between the 1989 and 1990 data, between urban and rural dwellers, and between households with and without a blue box. The publication was distributed to a wide audience including all Ontario jurisdictions working on waste management master plans.

Award: **$5 000**

497 "The Rainbow Connection: An Environmental Careers Fair for Students," Fall 1990

E. Brady

681 Cherrywood Dr.
Burlington, ON
L7T 3W9

PE 9120

The objective of the fair was to increase students' awareness of career opportunities in the environmental field. This was accomplished through presentations by persons working in this field and an examination of volunteer work as an immediate avenue for students to gain environmental experience.

Award: **$1 100**

498 Hamilton/Wentworth Natural Areas Inventory, April 1992

Hamilton Naturalists Club

P.O. Box 5182
Hamilton, ON

PE 9124

Due for publication April, 1992, this two-volume report will be compiled by professional biologists. It will detail baseline floral, faunal, and hydrological data for existing Environmentally Sensitive Areas and all other identified natural areas in the region. The report will provide a scientific basis for future land use and water management decisions.

Award: **$8 201**

499 "Waste Less Times" Newsletter

Citizens' Clearinghouse on Waste Management

R.R. #2
Cameron, ON
KOM 1GO

PE 9125

A quarterly newsletter dealing with a broad range of waste management issues with the primary objective of promoting the 3R's. Matters addressed include centralized composting, material recovery facilities, hazardous wastes and the car as a source of waste.

Award: **$9 600**

500 Production of "Art and the Environment" Conference brochure, April 19-21, 1991

Artists' Alliance for the Environment

66 Roslin Ave.
Toronto, ON
M4N 1Z2

PE 9126

A conference and arts festival providing a forum for artists and arts educators to explore environmental responsibilities, the safety hazards of various artists' materials and opportunities for positive personal involvement. Events included lectures, workshops, an environmental art exhibit, displays and various forms of entertainment.

Award: **$5 000**

501 Environmental Publications: "An Ecotour of Toronto" and "A Handbook of Ecology Parks In Schoolyards"

Toronto Environmental Alliance

2nd Floor, 456 Spadina Ave.
Toronto, ON
M5T 2G8

PE 9129

"An Ecotour of Toronto" provides information on how to arrange a tour of various waste management enterprises and facilities in the Toronto area such as the Keele Valley Landfill site. The second publication is a guide to Toronto's natural spaces. Both publications will be distributed free of charge to schools or sold to the general public for a small fee.

Award: **$7 000**

502 Video: "Yes Environmental Success"

T.C. Video Productions

Apartment 1, 4 Melrose Ave.
Toronto, ON
M5M 1Y5

PE 9130

Filmed at Monteverde Cloud Forest Reserve, Costa Rica, this video highlights the Monteverde Conservation Project, an environmental success story. The aim is to develop positive attitudes to environmental protection in Ontario schools. Local environmental initiatives are also featured. The film is available at no cost to local teachers through the Ontario Teachers Federation.

Award: **$6 000**

503 "Organizing for Waste Reduction" Conference, October, 1990 and Public Outreach Program

It's Not Garbage

c/o Toronto Environmental Alliance
Suite 104, 401 Richmond St. W.
Toronto, ON
M5V 3A8

PE 9132

'It's Not Garbage' is a coalition of community, labour, business and environmental groups advocating the need for an aggressive campaign to reduce Metro Toronto's solid waste. This particular conference identified opportunities for local waste reduction

projects and methods for involving people in these projects. The outreach program aims to get the 3Rs message across to the chinese, caribbean, italian and portugese communities.

Award: **$37 000**

---

504 Program to Monitor Implementation of U.S. Clean Air Act and Canadian Acid Rain Legislation

The Canadian Acid Precipitation Foundation

Suite 401, 112 St. Clair Ave. W.
Toronto, ON
M4V 2Y3

PE 9138

This program will monitor implementation of amendments to the U.S. Clean Air Act. This legislation is aimed at controlling emissions of acid rain precursors, air toxics, ozone and those from motor vehicles. It will also monitor the implementation of local acid rain legislation, particularly that in Ontario, Quebec and Manitoba.

Award: **$48 000**

---

505 Recycling Week/90 Poster designed by Heather Cooper

Recycling Council of Ontario

Suite 504, 489 College St.
Toronto, ON
M6G 1A5

PE 9139

An original poster printed on paper with 50% recycled content using vegetable-based ink. Its basic message is that time is running out. Something must be done to save the environment immediately. Otherwise, there will be nothing left to save in the future. 15,000 copies were distributed.

Award: **$39 852**

---

506 "EnviroHome: Our Home Is Our Planet" Program

EnviroHome

49 Wellington St. E.
Toronto, ON
M5E 1C9

PE 9140

A multi-faceted environmental awareness program designed to show the general public how they can help the environment through changes in their home. The program consists of a travelling exhibition of products and services householders should consider using, an educational outreach program for in-school use across Canada and an entertaining and informative activity workbook which reinforces the EnviroHome message.

Award: **$50 000**

---

507 Great Lakes Alive Project

Trees For Today and Tomorrow, and The Environmental Hazards Team for the Great Lakes Inc.

Suite 206, 44 Eglinton Ave. W.
Toronto, ON
M4R 1A1

PE 9152

Project focusses on emphasizing the crucial importance of the Great Lakes and their watersheds to large numbers of students and community groups. This is achieved by actively involving them in an integrated aquatic and terrestrial education and environmental rehabilitation and reforestation program. Printed, audio-visual and other communications material will be produced to support program objectives.

Award: **$45 000**

---

508 "Venture Engineering and Science Camps" Program

Faculty of Engineering
McMaster University

1280 Main St. W.
Hamilton, ON
L8S 4L7

PE 9164

A two-part regional program in the Hamilton-Wentworth area promoting interest in engineering and science in elementary students. The campaign was particularly aimed at females. Its first part consisted of an interactive, hands-on science workshop presented to over 100 classes. The second part involved week-long day camp sessions which took groups of 24 children through a series of project demonstrations and field trips. Almost 200 children attended.

Award: **$1 000**

Funds from the Cleansweep Lottery

A total of $1 920 007 was allocated to 61 projects from funds provided by the Cleansweep lottery.

Projects funded fell into three categories;

- Environmental Protection and Awareness
- Great Lakes Remedial Action Plans.
- Water Related Research

Environmental Protection and Awareness

Public awareness projects were the focus of this category. Raising awareness of environmental and conservation issues and promoting the adoption of environmentally friendly practices were key objectives. Projects to this end included videos and films, literature, and public workshops and forums. Technical environmental conferences and community clean-up projects also came under this section.

Great Lakes Remedial Action Plans

Projects supported in this category related to rectifying Ontario waterways where there was no existing funding or program to deal with the issue, and where the "polluter pays" principle could not be put into effect.

Water Related Research

This sector featured basic and applied research projects by universities and conservation authorities in areas such as pollution abatement and groundwater contamination. Analytical method and instrument development projects were also supported.

With the cancellation of the Cleansweep lottery, no further funds are available from this source. All funds committed to projects have been distributed.

Projects in Progress During 1990/91

Environmental Education and Awareness

509 "The Green Household": An Environmental Self-Help Film

Caber Film and Video Company Ltd.

Unit 18, 18 Automatic Rd.
Brampton, ON
L6S 5N4

PE 9113

Research and script development costs of this 60-minute film exploring how one can improve the environment by changing one's lifestyle. Emphasis is on waste reduction and water and energy conservation. The film is intended for a general audience and will be broadcast on commercial and educational television. It will also be available in video format.

Award: **$25 000**

510 Documentary Film: "A Cry for the Common Loon"

Front Porch Film and Video

285 Romaine St.
Peterborough, ON
K9J 2C6

PE 9144

Post-production costs of a 24-minute film on the adverse effects of acid rain on the breeding success of the common loon in the Sudbury Basin. The film investigates clean-up operations and industry's commitment to reduce sulphur dioxide emissions. The work of the Canadian Coalition on Acid Rain and the U.S. Clean Air Bill are also examined.

Award: **$5 000**

511 "Cities For A Cooler World" Project

Friends of the Earth

Suite 701, 251 Laurier Ave. W.
Ottawa, ON
K1P 5J6

PE 9146

Project aims to convince 6 or more Canadian cities to commit themselves, by June 1992, to a 20% reduction in their carbon dioxide emissions from 1988 levels by the year 2005. This demonstrated commitment by major Canadian cities could encourage the federal government to call for a strong international treaty on global warming.

Award: **$15 000**

512 "Energy and Environment — The Next Generation" 1991-92 Calendar

Solar Energy Society of Canada

3-15 York St.
Ottawa, ON
K1N 5S7

PE 9148

Teacher/student calendar promoting energy conservation and environmentally acceptable behaviour. The calendar was based on original art work by elementary school students. This provided them with the opportunity to express artistically what environmentally-sound energy alternatives they would like to see developed for their generation. The calendar was distributed free of charge to 850 schools.

Award: **$5 000**

513 "Alternatives" Magazine

University of Waterloo
Faculty of Environmental Studies

Waterloo, ON
N2L 3G1

PE 9150

Publication of four issues of Alternatives on the topics; "Environment Advocacy and the Arts", an open theme issue, "Aboriginal Peoples and Resource Management", and a twentieth anniversary issue. Published quarterly, Alternatives is a scholarly journal and newsmagazine which provides critical and informed analysis of environmental problems, related social issues and technological developments.

Award: **$10 268**

514 Video: Environmental Problems in the Bay of Quinte

Quinte Environmental Resource Alliance

273 Front St.
Belleville, ON
K8N 5B3

PE 9151

A 20-minute video for school children in Grades 5-7 outlining environmental problems in the Great Lakes Basin. The Bay of Quinte is used as the example. This area has been identified by the International Joint Commission as one of the 42 areas of concern in the Great Lakes ecosystem. The film will be provided to all area primary schools free of charge.

Award: **$16 000**

515 Sustainable Development Community Education Model Workbook

Trinity Theatre

525 Adelaide St. E.
Toronto, ON
M5A 3W4

PE 9153

Trinity Theatre's Sustainable Development Community Education Model aims to develop a strategy for involving various sectors of a community in the achievement of sustainable development within the context of specific local conditions. This workbook will identify the individual components of this strategy and provide assistance to communities seeking to achieve sustainable development.

Award: **$5 000**

516 "Earthroots" Newspaper

Earthroots Coalition

Suite 307, 19 Mercer St.
Toronto, ON
M5V 1H2

PE 9154

Publication addresses environmental issues associated with hydro-electric development in the Hudson/James Bay region. This includes the impact of dams, river diversions, flooding, transmission lines and clearcutting. The newspaper also examines the effect of development on various stakeholders including native peoples. 200,000 English copies and 5,000 French copies will be distributed free.

Award: **$9 000**

517 Environmental Advisory Network of Waterloo

University of Waterloo
Faculty of Environmental Sciences

Waterloo, ON
N2L 3G1

PE 9155

The network is a body of experts in various environmental disciplines. Its primary mandate is to liaise between those individuals and organizations requiring environmental information and those able to provide it. The network provides consulting services and public speakers at minimal cost. Contribution was for speech preparation and advertising.

Award: **$800**

518 Broadway-Style Musical: "Come Save Today"

Stage Kids Children's Education Theatre Production of Metropolitan Toronto

95 Mimico Ave.
Etobicoke, ON
M8V 1R4

PE 9156

Through the medium of a live musical production, current environmental problems and possible solutions were addressed. The performance was given by and intended for senior elementary and secondary school students. Issues touched upon included waste reduction, environmentally friendly household products, toxic chemicals, global warming and deforestation. Thirty five performances were given to an audience of about 28,000.

Award: **$25 000**

519 Environmental Audit Handbook

Earth Day Ontario

6 Dermott Pl.
Toronto, ON
M5A 3B6

PE 9160

Questionnaire and information booklet allowing individuals to determine the impact of their lifestyles on environment. Focus is on the encouragement of waste reduction, energy and water conservation, and the reduced use and safe disposal of hazardous household products. Those who wish can participate in a year-long waste reduction program which will chart their progress toward an environmentally friendlier lifestyle. Copies of the handbook are available at 1-800-263-8799.

Award: **$26 000**

520 Television Series: "The Green Show: What Can I Do?" and "The Family Action Planner" Workbook

Soma Film and Video

Suite 200, 345 Carlaw Ave.
Toronto, ON
M4K 1H7

PE 9161

Research and script development costs for a 6-part series on what one can do to improve the environment. Program topics deal with garbage, water, air, earth, energy, and the community and beyond. The workbook provides additional information on how to achieve an environmentally acceptable lifestyle. A 2-hour home video will be re-cut from the series.

Award: **$50 000**

521 Educational Material related to Tree Day, April 25, 1991

The Evergreen Foundation

Apartment 2104, 71 Simcoe St.
Toronto, ON
M5J 2S9

PE 9162

Material includes an eight page newspaper insert entitled "It's an Evergreen World". This was distributed through the Globe and Mail on April 18, 1991. In addition, educational packages on the environment intended for students from kindergarten to Grade 9 were produced. Over 1000 of these were distributed to schools in the Greater Toronto area.

Award: **$18 800**

522 Teacher's Guides for Educational Video "The Adventures of Ricky Raindrop"

Arthur Holbrook Productions
KLA Visual Productions

314 Fairmont Ave.
Ottawa, ON
K1Y 1Y8

PE 9166

Preparation of teacher's guides for selected units of this 15-part animated video series dealing with various water issues. The series is suitable for Grades 4-8. Program topics include the water cycle, groundwater, water pollution, acid rain and aquatic ecosystems. The series is intended for the educational market in Canada and the United States.

Award: **$25 000**

523 "Environment in the 1990's — An Educational Series for Young Canadians"

Paradigm Communications

324-A Somerset St. W.
Ottawa, ON
K2P OJ9

PE 9167

Research and development costs of the pilot video for this series along with the production of a teacher's guide. Intended for students aged 12 to 16, this series will consist of 20 15-minute video programs on a wide range of environmental subjects. Each segment is supported by information packages for both students and teachers.

Award: $25 000

524 Educational Television Series: "The Adventures of Dudley the Dragon"

Breakthrough Films and Television Inc.

Suite 331, 67 Mowat Ave.
Toronto, ON
M6K 3E3

PE 9168

Research and script development of selected units of this 12-part animated series on the environment. The target audience is children aged six to eight. Topics covered include the effects of pollution, acid rain, the 3Rs, the need for clean air and water and energy conservation. The series will be shown across Canada on educational television.

Award: $25 000

525 "Clean Up Your Act" Public Education Campaign

Forevergreen Television and Film Productions Inc.

Suite 203, 181 Carlaw Ave.
Toronto, ON
M4M 1S2

PE 9170

Research and development costs for the first phase of this multi-media public education/action campaign. The strategy is designed to encourage lifestyle changes and effective waste management strategies. This message will be communicated through television, public service announcements, home videos, and appropriate support materials.

Award: $25 000

526 Publication of Proceedings for the "Algonquin Park: The Next 100 Years" Conference, June 23, 1990

Wildlands League

Suite 406, 517 College St.
Toronto, ON
M6G 4A2

PE 9171

Conference dealt with various park issues including wildlife population dynamics, the implications of forestry activities on natural park values, trends in recreational use of the park, and the adequacy of the park's wilderness and nature reserve systems. Published proceedings will include contents of speaker presentations and panel discussions, and a policy statement from Wildlands League.

Award: $5 500

527 Photographic Slide Collection on the 3R's

P. Fry

36 Orwell Cres.
Barrie, ON
L4N 6M6

PE 9172

Collection will be used in Simcoe County schools as a visual resource for environmental studies programs. It will consist of 150-200 locally oriented slides. Selected photographs, accompanied by a short text, will be reproduced in an accompanying pamphlet.

Award: $23 500

528 School Tour of Environmental Play "Brazil Nut"

Carousel Players

P.O. Box 372
St. Catharines, ON
L2R 6T7

PE 9174

A participatory play for children in Kindergarten to Grade 3 emphasizing the inter-connection of life in a natural habitat. Combining elements of music, dance and mime, it tells the tale of the Brazilian rain forest and the effect on it of man's activities. The play will be performed in schools throughout southern Ontario between January and May, 1992.

Award: $20 000

529 Law Day Activities, April 17, 1991

Canadian Bar Association

Suite 200, 20 Toronto St.
Toronto, ON
M5C 2B8

PE 9175

Two events at Law Day were supported. The first was a mock trial tournament where secondary school students from across Ontario had the opportunity to argue a case under the Environmental Protection Act. The second event was an essay contest on the theme "Law and the Environment." Both activities increased awareness and knowledge of environmental laws among secondary school students and the general public.

Award: **$15 500**

530 Downspout Disconnection Campaign

City of St. Catharines

P.O. Box 3012
St. Catharines, ON
L2R 7C2

PE 9176

Public education campaign to encourage citizens in St. Catharines to disconnect their downspouts from the municipal wastewater system. The objective is to reduce the frequency of sewer overflows and the volume of dilute sewage reaching sewage treatment plants under heavy rainfall conditions. The campaign consisted of a public meeting, presentations and the distribution of information packages and brochures.

Award: **$10 000**

531 Harbourfront Limnology Lectures, Spring 1991

Harbourfront

410 Queen's Quay W.
Toronto, ON
M5V 2Z3

PE 9177

A series of four limnology lectures aimed at environmental groups and the general public. Issues examined included an update of the zebra mussel situation, toxins, drinking water and water management.

Award: **$5 600**

532 Environmental Awareness Seminar for Secondary School Students

Earth Think

55 Newman Dr.
Cambridge, ON
N1S 1A1

PE 9178

The seminar addresses a wide range of environmental issues focussing on what individuals can do to bring about positive change. Topics of discussion include the effect of individual actions on the environment, the impact of mass media and the negative effects of man's desire to dominate the natural environment.

Award: **$4 000**

533 Environmental Play: "The Future is R's," May, 1991 - June, 1992

Inner Stage Theatre

6th Floor, 9 St. Nicholas St.
Toronto, ON
M4Y 1W5

PE 9180

Staging of a participatory play dealing with various environmental issues such as air and water pollution, loss of wildlife and the importance of practising the 3R's. A tour of schools and community centres began in September, 1991. By the end of the tour, it is estimated that the play will have been performed 100 times to a total audience of 30,000 people.

Award: **$11 000**

534 Environmental Play: "Drink the Mercury"

The Sault Youth Theatre

14 La Chaumiere Pl.
Sault Ste. Marie, ON
P6A 6P6

PE 9182

This play focusses on mercury pollution and the overall problem of industrial waste and its impact on the environment by recounting the consequences of mercury poisoning at Minamata Bay, Japan. Suitable for both young and adult audiences, play will be widely performed. An audience of over 15,000 is anticipated. Printed support materials include a flyer on mercury pollution.

Award: **$11 775**

535 Global Laboratory Environmental Monitoring Project

Gananoque Secondary School

William St.
Gananoque, ON
K7G 2V2

PE 9183

An international environmental research project linking secondary school students, teachers and scientists from around the world through a computer network. The project consists of hands-on scientific investigations of global ecology and human-induced climate change. In the case of Gananoque Secondary School, senior students will monitor the Gananoque River on an on-going basis for chemical and biological indicators of its health. Solutions to local and global environmental problems will be addressed.

Award: **$1 200**

536 Research and Writing of "Biotechnology," a chapter in "Environment On Trial"

Canadian Institute for Environmental Law and Policy

Suite 400, 517 College St.
Toronto, ON
M6G 4A2

PE 9184

The chapter will examine the new and growing biotechnology industry and its environmental implications. Special attention will be devoted to the regulatory framework concerning biotechnology issues and to several key regulatory issues.

Award: **$15 000**

537 "Wastewise" Project

Wastewise (Halton Hills) Community Resource Centre

20 Wildwood Rd.
Georgetown, ON
L7G 2W8

PE 9187

A major initiative to divert waste from landfill and to educate the public on the need to practice the 3R's. Project involved setting up a depot to receive reusable goods such as clothes, books, furniture, appliances, tools and any other articles that can be reused, repaired and sold. Financial contribution went towards advertising the facility and for educational and display materials.

Award: **$16 100**

538 Series of Community Publications

Citizens' Clearinghouse on Waste Management

R.R. #2
Cameron, ON
KOM 1GO

PE 9189

Grant awarded toward production and distribution of 5 booklets on the following topics: waste management economics, centralized composting, reusables vs recyclables, systems for maximizing waste reduction, and waste reduction guide for businesses. 2,000 free copies of each booklet will be distributed to general public and interested parties throughout Ontario.

Award: **$25 000**

539 Backyard Acid Rain Kit (BARK) for 1991-92 Monitoring Program

Public Focus

Suite 500, 489 College St.
Toronto, ON
M6G 1A5

PE 9191

The BARK program is a bi-national project designed for students in grades 4-10 involving them in a scientific study of acid rain issues. Students participate by monitoring the acidity of local precipitation. Data from this is assimilated at Queen's University to produce an accurate portrayal of acidity levels in precipitation across Canada.

Award: **$10 000**

540 Children's Environmental Festival, November, 1991

Public Focus

Suite 500, 489 College St.
Toronto, ON
M6G 1A5

PE 9192

An annual event for elementary school children in Grades 4-6 designed to raise environmental awareness. It consists of theatre performances, presentations, displays, games and other activities on environmental themes. Each year, the program is updated with the introduction of new activities and presentations.

Award: **$25 000**

541 Children's Environmental Outreach Program, 1991-92

Public Focus

Suite 500, 489 College St.
Toronto, ON
M6G 1A5

PE 9193

A hands-on program for children aged 6-12 consisting of interactive games and activities. The objective is to foster an awareness of environmental issues and to encourage environmentally responsible behaviour. The program is run year-round by Public Focus staff at elementary schools, community and recreation centres, summer camps and parks.

Award: **$10 000**

542 Summer Institute for Environmental Values Education, July 19-26, 1991

The Harmony Foundation of Canada

19 Oakvale Ave.
Ottawa, ON
K1Y 3S3

PE 9195

Support materials for this annual eight-day program which assists educators to improve their ability to address environmental issues in their classrooms and communities. This approach brings together educators and resource people from Canada and abroad to explore global, native, community and personal aspects of environmental issues.

Award: **$4 500**

543 Environmental Poster and Activity Booklet

The Harmony Foundation of Canada

19 Oakvale Ave.
Ottawa, ON
K1Y 3S3

PE 9196

Production of a colourful poster for school children showing the impact of man's activities on the environment, and how people can work together to find solutions. An accompanying booklet assists educators in explaining difficult concepts such as acid rain and ozone depletion.

Award: **$8 633**

544 Development of "Growing Up Green" Guide

The Harmony Foundation of Canada

19 Oakvale Ave.
Ottawa, ON
K1Y 3S3

PE 9197

Intended to be an amusing and informative guide for children teaching them how to live in an environmentally friendly way.

Award: **$15 000**

545 Community Workshops for the Environment: An Organizer's Manual

The Harmony Foundation of Canada

19 Oakvale Ave.
Ottawa, ON
K1Y 3S3

PE 9199

Production of a "how to" manual to assist interested individuals and community groups in the development, advertisement and provision of environmental workshops in communities across Canada. Such workshops teach the practical skills required by individuals and communities to contribute to environmental solutions. This particular manual is based on the Home & Family Guide: Practical Action for the Environment.

Award: **$10 000**

546 One-day Workshop on Municipal-Industrial Strategy for Abatement, April 17, 1991

The Pollution Probe Foundation

12 Madison Ave.
Toronto, ON
M5R 2S1

EC 9087

This workshop addressed the question of how to incorporate pollution prevention into the MISA program. As a result, a short- and long-term reform strategy for this program was formulated. Participants at the forum included representatives from the ministry, Environment Canada, the municipal sector, industry, public interest groups and the United States.

Award: **$3 745**

547 Conference to Launch Ontario Chapter of the Canadian Environment Industry Association, October 16, 1991

Canadian Environment Industry Association

Suite 401, One University Ave.
Toronto, ON
M5J 2P1

EC 9088

The association represents a very broad range of environmental protection companies producing products and services which provide environmental solutions. Its basic role is to help the Canadian environmental industries sector expand and grow in both domestic and export markets. The conference theme was "Our Environmental Industry in the Making" and was attended by over 150 people.

Award: **$15 000**

548 Junction Creek Park Project

Ukrainian Senior's Centre

30 Notre Dame
Sudbury, ON
P3C 5K2

CC 001

A Ukrainian seniors community project to beautify and stabilize the banks of this creek through the planting of trees and shrubs. Approximately 100 trees will be planted. This will result in the extension of the lineal park along Junction Creek.

Award: **$15 000**

549 Lake and Shoreline Management Study of Brady Lake

Ryerson School of Urban and Regional Planning

350 Victoria St.
Toronto, ON
M5B 2K3

CC OO2

This study will assist municipality and community interests in the vicinity of Brady Lake to plan for shoreline development by suggesting planning and management policies. The overall objective is to use Brady Lake as a case study for the implementation of a land use model based on the development carrying capacity of the lake.

Award: **$6 000**

Great Lakes Remedial Action Plans

550 Development of a Bay of Quinte RAP Environmental Information Package to Enhance the Use of the "Time to Decide" Video and Provide Ongoing/Consistent Environmental Awareness

Faculty of Education
Queen's University

Kingston, ON
K7L 3N6

ERAP 02

Development of an environmental awareness kit to explain environmental concerns in the Bay of Quinte area. These issues include excessive algae growth, toxic contamination and shoreline destruction. This information package, including literature, slides, posters and videos, will be an ideal complement to the more technically oriented video.

Award: **$30 000**

551 Tributary Rehabilitation and Erosion Control (Severn Sound)

Wye Marsh Wildlife Centre

P.O. Box 100
Midland, ON
L4R 4K6

ERAP 03

Amelioration of the excessive nutrient enrichment and algal growth in the Sound. This impaired water quality is caused by extensive erosion and unrestricted livestock access along the tributary streams that drain into it. Various options including fencing are being considered and implemented to achieve this objective. Improved recreational opportunities and a healthy naturally producing fish and wildlife population will result.

Award: **$45 000**

552 Black Ash Creek Rehabilitation and Erosion Controls

Nottawasaga Valley Conservation Authority

R.R. #1
Angus, ON
L0M 1B0

ERAP 04

Creation of a vegetated buffer zone along the banks of this river and its tributaries. Once completed, the resulting reduced runoff and lower peak flows will lead to a reduction in water phosphorus inputs. As well, restricted livestock access will reduce erosion and nutrient loading. Collectively this will lead to improved fish spawning habit and water quality.

Award: $30 000

553 Wetland Creation: Thommy Thompson Park, Leslie Street Spit

Metropolitan Toronto Region Conservation Authority

5 Shoreham Dr.
Downsview, ON
M3N 1S4

ERAP 06

Establishment of a wetland complex at this location incorporating native and local plant species in select enbayment cells. Creation of this wetland would provide food, shelter, shade and spawning habit for a variety of cool, warm water and forage fish species.

Award: $25 000

554 Agricultural Demonstration Project: No-Till Demonstration (Severn)

North Simcoe Soil and Crop Improvement Association

c/o Ontario Ministry of Agriculture and Food, Elmvale Office
P.O. Box 340
Elmvale, ON
L0L 1P0

ERAP 09

Continuation of the association's no-till demonstration project and the setting up of other demonstrations of agricultural source pollutant control systems. These include manure storage facilities, cover crops to reduce soil erosion, milk house waste treatment and controlling livestock to streams.

Award: $10 000

555 Demonstration Project for Improved Subdivision Design and Planning and Construction Practices

Metropolitan Toronto and Region Conservation Authority

5 Shoreham Dr.
Downsview, ON
M3N 1S4

ERAP 10

Demonstration of the availability and ability of effective technology and planning/review procedures to improve construction practices for subdivisions within the Greater Toronto Area. The ultimate objective of improving this process is to reduce many of the negative impacts of construction on watercourses. These include soil erosion, destruction of vegetated buffer zones and degradation of fish habitats.

Award: $25 000

556 Don River Reborn Film

The River Production Company

Suite 1107, 131 Bloor St. W.
Toronto, ON
M5S 1R1

ERAP 11

Production of a film chronicling the flow of the Don River from its headwaters in the Oak Ridges Moraine to its mouth on Toronto's waterfront. This 52 minute made-for-television film focusses on the Don River's restoration efforts and how this serves as a model for discovering and analyzing environmental problems and solutions in a watershed.

Award: $ 33 500

557 Bay of Quinte: Community Information and Coordination Office

Bay of Quinte RAP Public Advisory Committee

P.O. Box 183
Newburgh, ON
K0K 2S0

ERAP 14

The advisory committee is a public interest group which advises the Bay of Quinte Remedial Action Plan Team and promotes environmental awareness in the area.

Award: **$32 500**

Water Related Research

Summaries of water related research projects are contained in the water quality (refer to codes 053 and 155-164) and analytical methods and instrument development (refer to code 189) sections of the Environmental Research Program.

Technology Transfer

Overview

A feature of the activities of the Research and Technology Branch during the year was the increasing emphasis given to technology transfer initiatives. This reflected the importance to the branch of being more actively involved in the dissemination of scientific and technical information to an increasingly diverse audience.

Technology transfer is the process through which the results and implications of research and technological developments are made available to an end user or incorporated into their activities. It may also include the dissemination of this information to a general audience for educational purposes. With the wealth of information being generated from projects supported by the Environmental Research and Environmental Technologies Programs, the importance of this role to the mandate of the ministry is immense.

An effective technology transfer program can have many tangible and intangible benefits. It can:

- enhance the reputation of the ministry and the branch in the view of technology and research based organizations
- raise awareness of the various support programs coordinated through the branch and that of its other activities within and beyond its traditional audience
- encourage the establishment of ongoing linkages between ministry scientific, regulatory and policy development personnel, and the research community and industry
- facilitate the rapid incorporation of research results and technology developments into ministry scientific, policy and regulatory processes
- stimulate new avenues of research and technology development
- provide recognition and new professional opportunities for individual researchers or companies

1990 Technology Transfer Conference

On a formal level, the key element of the year's program was the 11th annual Technology Transfer Conference held on November 19 and 20 at the Royal York Hotel in Toronto. The 1990 conference attracted 800 delegates from universities, private laboratories and consulting firms, industry and government.

The conference, opened by the Hon. Ruth Grier, Minister of the Environment, featured two keynote addresses. "Sustainable Development: The Technological Challenge" was the topic addressed by Dr. Dirk Pilari of the United Nations Centre for Science and Technology for Development. Dr. Jim Bruce, Chair of the Canadian Climate Program Board spoke on "Responses to Global Climate Change: The Coming Environmental and Economic Revolutions".

As in previous years, the conference technical program was structured according to the six research areas of the Environmental Research Program. These sessions were led by nine feature presentations with a further 70 oral and 36 poster presentations on internal and external research projects.

The final conference activity was a 90 minute panel discussion on "Global Warming: What

is at Stake" chaired by Dr. Harold Schiff of the Canadian Institute for Research in Atmospheric Chemistry. The session focussed on a broad range of relevant issues including industrial perspectives, socio-economic impacts, media responsibilities and government policies and strategies.

Other Extension Activities

The Research and Technology Branch was also actively involved in a number of other environmental forums during the year. A great deal of interest has been generated by the branch's programs which are becoming well known throughout North America and Europe.

The years activities included:

The Swedish Trade Council, Environmental Seminar, Montreal. Presentations were given on "Business Opportunities in Waste Management" and "The Ontario Environmental Protection Industry" (May).

Quebec Ministere de l'Industrie, de Commerce et de la Technologie, informational meeting organized by the Ontario Ministry of Industry, Trade and Technology. A presentation was made by branch staff on the Environmental Technologies Program and other Ontario environmental programs (August).

Canadian Environmental Trade Mission to the Netherlands and Eastern Europe, meeting organized by ISTC, International Trade Canada and Investment Canada. The branch programs were presented and invitations were received to join the trade mission (August).

Universite de Montpelier; International Meeting: Rencontre Canada — Europe: Environnement et dechets, France. An invited presentation to present perspectives on environmental research and technology as part of Ontario's continuing participation in the "Four Motors" initiative (October).

International Joint Commission, Great Lakes Advisory Board, Technology Committee. An invitation to present ministry programs in the context of research and technology development needs for spill prevention in the Great Lakes (October).

Future Directions

The most pressing task facing the Research and Technology Branch is its consolidation after a period of rapid growth. The branch is faced with the challenge of refining its structure so that it can operate in the most efficacious manner possible, and of updating its administrative and management systems to accommodate its continuing growth in mandate, staff and budget.

To this end, the services of management consulting teams were used to review and analyze segments of the branch program. Many recommendations for increasing efficiencies and improving levels of service have already been implemented. Other means for improvement will be continually sought in order to enable better delivery of the branch mandate and further the objectives of the ministry.

The branch has defined two priorities for the upcoming year The first is the enhancement of the communication of research and technology achievements that have been made possible through ministry support. The cornerstone of this will be the publication of a research and technology bulletin, "The Proving Ground". This bulletin will be written for and distributed to a diverse technical and general audience. This Report on Environmental Research, Technology Development and Awareness Activities, to be published annually, will further support this objective. These initiatives will build upon the solid foundation and reputation provided by the annual Technology Transfer Conference.

Further advances in fulfilment of this goal will be made by hosting and participating in greater numbers of international meetings, symposia and conferences. Profiling the nature and achievements of branch programs will be essential to their continued success.

Secondly, the branch will be coordinating the compilation of a strategic long-range research needs document which will improve the focus of its research and technology development activities. This process will involve broad consultation with experts in fields ranging from waste diversion to biotechnology and socio-economic research. This sharper definition of the ministry's present and future requirements in research and technology development will contribute significantly to the achievement of program goals.

Report on Environmental Research, Technology Development and Awareness Activities, 1990-91

Editor: Roger Scott
Contributor: Nadia Kuzmitsky
Technology Transfer Coordinator (Acting): Jan Woelfle

Research and Technology Branch
Environment Ontario
135 St. Clair Ave. W.
Toronto, ON
M4V 1P5

Produced with the assistance of Public Affairs and Communications Services Branch

Project summaries in the four program sections are based on the most recent written reports or proposals supplied to Environment Ontario. While all care is taken in interpretation, the Research and Technology Branch cannot be held responsible for absolute correctness or sufficiency of information. Many research and technology development projects are complex and often multi-year undertakings. Caution should be exercised in extrapolating objectives, results or conclusions out of their original context. Any views, ideas, or conclusions do not necessarily reflect the views and policies of Environment Ontario, nor does mention of trade names, commercial products or processes, constitute endorsement or recommendation for use.

Keyword Index

(Research and Technology Development)

Codes *001-205* Environmental Research Program Projects
206-418 Final Reports of Environmental Research Projects
419-438 Environmental Technologies Program Projects

A

AAexpert 112
acidification of lakes 030, 038, 044, 048, 065, 066, 067, 068, 258, 337, 338
acid rain 004, 031
ACexpert 112
ACselect 112
activated carbon 029, 041, 422, 429
activated silica 430
ADOM 020, 148
aerators 431
aeration systems 173
aerosols 233
Agnew lakes 346
aggregate extraction 018
agricultural practices and activities 036, 046, 047, 073, 079, 083, 136, 140, 153, 154, 156, 160, 161, 172, 174, 181, 188, 195, 390
air conditioners 137
air pollution standards 146
aldrin 117
algae 030, 044, 314, 329
algal mats 030
algal collection 044
aliphatic amines 251
Alliston 043
aluminum 007, 242
ammonium 181
amphipods 069, 338
Anabena 329
Anodonta grandis 068
aquifers 042, 043, 054, 080, 171, 187, 292, 313, 343, 354, 355
aromatic hydrocarbons 089
artificial marsh 283, 345
arsenic 113, 120
asbestos 220
ash residue 010
Atikokan pilot test 292
atmospheric nitrates 438
atomic absorption spectrometry 006, 110, 112
atrazine 169
automated batch hydride generator 120
automatic preconcentration sampler 111
AZA-polycyclic aromatic hydrocarbons 407

B

backfill materials 092, 370
bacteria 010, 037, 047, 063, 083, 118, 139, 156, 160, 184, 188, 195, 299, 318, 324, 397, 406
batch incineration of biomedical waste 010
batteries 435
beaches 125, 395
benthic invertebrates 062, 176
benthic organisms 320
benzene 010, 089
Bifidobacterium 118, 195
bioaccumulaton 135, 300
bioassays
- aquatic contaminants 086
- *Daphna magna* 082
- diethylnitrosamine 086
- heavy metals 144
- industrial effluent 082
- mutagens 256, 269, 293
- organic pesticides 144
- organochlorines 058
- rainbow trout 082, 086
- soil toxicants 144
- *Tetrahymena vorax* 082

biococentration of mercury 166
biological response systems 290
biomedical waste 010, 185
biomonitoring
- chlorinated hydrocarbons 326
- environmental contaminants 308
- lake acidification 069
- networks 049
- protocols for aquatic insects 327
- trace contaminants 305
- uranium mining activity 351, 352, 353

Bio-Nurbel crushing machine 185
biotechnology 044, 201
biotechnology policy 417, 418

bird control systems 136
Black Creek 299
blast furnace slag 092
bleached kraft mill effluent 050, 064, 078, 164, 336
blue box 131
body residue model 071
breeding bird atlas 416

C

cabbage 218
cadmium 039, 101, 210, 280, 309
Canadian Oxidant Research Program 149
capital investment cycles 199
carbamates 193
carbon dioxide 066
carbon flux 066
carbon-soluble 156
carcinogens 050, 142, 332, 432
cauliflower 218
cement plants 252
centrifuge physical modelling 105, 106, 178
certified reference material 192
CFC's 151
chemical exposure pathways 135
chironomids 070
chloride 286
chlorinated aromatic hydrcarbons 224
chlorinated azobenzene 400
chlorinated dibenzo (p) dioxins 117
chlorinated hydrocarbons 070, 308
chlorinated organic compounds 077, 089, 411
chlorinated solvents 052, 060, 091, 100, 187
chlorination 259, 260
chlorination of effluent 276
chlorobenzene 034, 089
chloroethanes 034
chloroethylenes 034
chloroform 010, 255
chlorophenol analysis 115
chlorophenol degradation 003, 072
chlorophyll in lakes 059
chromium 170, 186
Cladophora 309
clams 290
clay 099, 364
clay liners for landfill 105, 106, 178, 367, 368, 375, 382, 383, 392
clay liner compatability 178, 375
climate change 066
coal fly ash 180
coal tar residuals 183
cobalt mining 277
coke oven emissions 227
coloured water 033, 426
combustion 025, 222
common loon 048
composting 103
conductivity mapping 159
copper 039, 297, 419
copper refinery waste 179
critical body residue
cut off walls 432
cyanide 371, 419, 423
cyanide analysis 119
cyanobacteria 044
Cyanosave 419

D

Daphna magna bioassay 082
decline index (sugar maple) 008, 143
degalvanizing 420
de-icing salt 040
de-inking of paper 437
Delia antiqua 415
dense gas dispersion modelling 023, 147
dielectric fluid products 254
diethylnitrosamine 086
dioxin 409
direct sample insertion 110, 123
disinfection by-products 425, 426
dissolved inorganic carbon 066
dissolved organic carbon 032, 033, 041, 154
DNA probes 195
domestic sewage treatment
domestic waste leachate 367, 368, 375, 382, 385
Don River 039, 077,
Dorset 005, 150, 166, 304
Dowling 342
Dreissena polymorpha 053
drinking water 171, 261, 263, 281, 425, 427
drinking water treatment 029, 033, 041, 259, 263, 281
drought 242
dust control 362
dyebath effluent 096

E

economy-environment linkages 132
effluent chlorination 260
effluent treatment 157, 423
electric vehicles 198
electrochemical cells 096
electrochemical membrane 421
electrochemical vaporization 123, 401
Elliot Lake 346
Elliptio complanta 068
emulsification 139
endosulfan 117

enteric bacteria 156
environmental valuation 126
enzyme immunoassay 122
epidemiology 285
erosion 088
Escherichia coli 037, 047, 063, 118, 160, 324
Essex county aquifer 080
ethanol 104
ETV 401
Eulerian model 004, 013
expert systems 051, 112, 311, 328, 423, 424

F

faecal coliform 063, 118
faecal indicator bacteria 037, 047, 063, 083, 118, 160, 318, 324
faecal pollution 037, 047, 063, 083, 118, 160, 318, 324
fertilizer 036
fathead minnow 035, 071, 163
fibreglass scrap recycling 434
fish
- fathead minnow 035, 071, 163
- freshwater 035
- rainbow trout 045, 050, 082, 084
- sport 031, 331, 393
- unspecified 048, 056, 061, 114, 145, 163, 164, 254, 258, 280, 282, 325, 332, 336
- walleye 257
- white fish 078
- white sucker 064, 076, 078, 297
- yellow perch 300

fish culture 045, 084
fish diseases 076, 312
fish growth 282
fish waste production 045
flame spectroscopy 405
flash photolysis 072
flow injection analysis 110
flow injection sample introduction 190, 196
fluorescence line imager 059
fluoride 027
Fonthill Kame 018, 250
food web dynamics 049, 166
forest plantation technology 296
forestry 414
formaldehyde 005, 024
fractured clay 99, 364
fractured rock 095
fractured shale 369
fly ash 092, 109

G

galvanized steel 420
gas chromatography 114, 169, 191, 401, 403, 438
gas chromatography/mass spectrometry 013, 109, 399, 403
gas migration 347
gasoline contaminated groundwater 322, 323
genetically engineered microorganisms 201
Geographic Information System 174
germanium 113
GESIMA 020, 148
glassification of hazardous waste 388
global warming 153
glyphosate 122
gold mining 419, 423
granulated activated carbon 029
greenhouse gases 153
ground penetrating radar 159
groundwater 168, 189, 422, 427
groundwater contamination
- bacteria 184, 188
- chloride 040, 286
- chlorinated solvents 052, 091, 100
- dissolved organic carbon 154
- gasoline 322, 323
- general 162
- hazardous organic chemicals 361
- immiscible liquids 091, 100
- industrial liquid waste 362
- inorganic contaminants 354, 355,
- nitrate 154, 171
- nitrogen 181
- organic solutes 379
- trichloroethylene 100
- VOCs 287

groundwater remediation 089, 187, 379, 432
grey water 330
Guelph 103, 171
Guelph pilot solid waste composter 103

H

Hagersville tire fire 129
haloaromatic hydrocarbons 234
halogenated hydrocarbons 012
halogenated organic compounds 429
Hamilton 006, 208, 209, 236, 273, 433
Hamilton harbour 433
hazardous chemicals 157, 203
hazardous contaminants 273
hazardous immiscible liquids 091
hazardous waste 403
hazardous waste glassification 388
hazardous waste sites 093

Heart Lake 314
heavy gas dispersion modelling 002, 246
heavy metals 017, 039, 101, 145, 170, 176, 177, 179, 200, 205, 210, 277, 278, 297, 339, 419, 423
HELP model 098
herbicides 115, 122, 169, 408
hexachlorobenzene 117
hexachlorobiphenyl 139
hexachloroethane 089
Hexagenia 058
high pressure liquid chromatography 072, 109
household consumer behaviour 131
human health 146, 151, 207, 208, 210, 213, 223, 228, 235, 236, 260, 275, 276
Humber River 284, 294, 299, 397
Hyalella azteca 069
hydride-forming elements 113, 120
hydrocarbon fuel-contaminated soil 159
hydrogen chloride 010
hydrogen peroxide 170, 219
hydrogen peroxide photolysis 072
hydrogeology of the Oak Ridges Moraine 168

I

ICP 405
ICP-AE 110, 123
ICP-MS 110, 123, 190
immiscible liquids 360
immunoassay 122, 169
immunological techniques 468
incineration flyash 398
inhaleable particulates 026, 221
input-output models 132

J

jack pine 027

K

Kam-Kota tailings site 107
Kenox process 291
Kirkland lake 321
Kitchener 171
Klebsilla pheumoniae 406

L

laboratory accreditation 124
Lake Muskoka 333
Lake St. Clair 053
landfill
- barriers 108
- covers 098, 381, 389, 391
- design 178, 180
- general 343 387
- infiltration 098, 357
- leachate 087, 101, 109, 184, 354, 355, 361, 358, 359, 363, 374
- leachate modelling 109, 344, 363
- leachate treatment 090, 097, 177, 374, 376, 377, 380
- liners 102, 105, 108, 180, 367, 368, 375, 382, 383, 392
- siting 205
- stabilization 108
- vegetation establishment 088, 377

LANDIS 424
Landsat TM 038
lead 009, 039, 101, 210, 309, 339, 280
Leda clay 099, 375
Lemna gibba 141, 204
liability insurance 349
lichens 346, 351, 352, 353
Listowel 283, 345
Listowel artificial marsh project 345
liquid membrane pertraction 186
livestock operations 154, 181
logging 074
long range transport of pollutants 004, 019, 148
low flow analysis 055, 165, 334, 335
lung disease 228, 235
lysimeters 098, 389

M

manure 079, 083, 154, 156, 161, 181
market policies for pollution control 130
marsh treatment system 278
mass spectrometry 110, 190, 193, 216, 394, 401
mercury 031, 101, 145, 166, 206, 257, 280, 300, 309, 331, 435
mercury-free batteries 435
metal bioaccumulation 068
metal etchants 421
metal finishing 421
methane 043, 057, 153,
methanogenesis 043
methylmercury 031, 257
microclimate 018, 250
micronutrients 177
microwave assisted digestion 116
microwave induced catalysis 012
microwave interrupted flow digestion 194
milkhouse effluent 073, 085
mineralization of water pollutants 155
mining 107, 275, 278, 340, 419, 423

MISA 049, 124, 427
models
- ADOM 020, 148
- Eulerian 004, 013
- GESIMA 020, 148
- HELP 098
- Picknett 002
- Soil Chemical Exchange and Migration of Radionuclides 205
- TILE 036
- 308 017

modelling
- air pollutants 004, 006, 011, 017, 020, 023, 134, 148, 152, 215
- aerosols 233
- agricultural chemicals 036
- agricultural watersheds 172
- bacterial movement 188
- chemical exposure pathways 135
- clay liners 105, 106, 178
- dense gas dispersion 023, 147
- economy 132
- electric vehicles 198
- fractured rock 095
- gas chromatography parameters 114
- groundwater contamination 042
- hazardous chemicals 203, 215
- heavy gas dispersion 002, 246
- heavy metals 200, 205
- landfill leachate 105, 344, 363, 424
- lead transport in air 009
- metal uptake by clams 068
- microclimate 250
- nuclear spill contigency 279, 306
- Oak Ridges Moraine 168
- organic chemical fate 288
- organic chemicals 238
- organic compounds 034, 055
- organic contaminants in fish 163
- oxidant formation 150
- ozone depletion 151
- ozone transport 148
- pollution control plants 157
- septic tank effluent 188
- soil and water loss 046
- soil ingestion of heavy metals 200
- stochastic modelling of water quality 301
- sugar maple growth 022
- tile drainage 172
- waste production from fish culture 045
- water demand management 128
- water pollutants 032, 034, 036, 040, 042, 056

monitoring
- air pollution 001, 016, 025, 152, 225, 244
- capital investment cycles 199
- groundwater 358, 387
- lake water quality 038, 059, 074 316
- mobile (air) 001, 016, 025, 152, 225
- odorous organics 251

mosses 346, 351, 352, 353
multivariate statistical analysis methods 016, 062, 247,
municipalities and the environment 197
municipal pollution control plants 157
municipal recycling 131
municipal solid waste 104
municipal waste recycling 131, 296
municipal water treatment 128
mutagens 134, 227, 256, 271,

N

nanofiltration membranes 426
napthalene 014
nebulizer 405
neoplasms 076, 086
neutron/proton activation methodology 006
Niagara River 070, 309
nitrated PAHs 438
nitrates 054, 272
nitrogen 156
nitrogen transformation 272
nitrosamines 438
nitrous oxides 005, 012, 133, 150, 153, 225
noise 137, 207, 213
non-aqueous phase liquids 100
non-polar organic liquids 367, 368, 382, 383
nuclear accidents 244, 279, 306
nuclear power 266
nutrients 172

O

Oak Ridges Aquifer 313
Oak Ridges Moraine 168
odorous organics 251
odour assessment 152
onion maggot 415
Ontario Health Survey 146
operational emergency management 023, 147
Opstor 315
organic carbon 042, 433
organic compounds 001, 014, 029, 041, 056, 093, 158, 191, 211, 238, 261, 263, 267, 268, 276, 288, 298, 379, 422, 425, 426, 427
organic vapours 133
organochlorines 058, 111, 192, 350
organophosphates 193
Ottawa River 279, 306
oxidant formation 150, 438
ozone 005, 019, 148
ozone depletion 151, 153

ozone pollution 217
ozone treatment of water 281
ozonation 259

P

PAHs 010, 070, 076, 111, 121, 133, 141, 142, 204, 229, 238, 402, 433,
PAH derivatives 076, 133, 204, 229
PAH photodegradation 204
paper de-inking 437
paper recycling 437
particle beam mass spectrometry 193
particulates 010, 133, 209, 245, 239, 425
PCBs 010, 061, 114, 121, 192, 319, 342, 348
PCDDs 114, 192, 230, 396, 398
PCDFs 114, 192, 396, 398
peanuts 217
peat 177
Pediastrum 065
pentachlorophenol 325, 372, 373
Peridinum spp. 065
perforated pipes-grass swale system 175
pest control 415
pesticides 172
pesticide alternatives 140
phenanthrene 402
phenanthrene PAH 402
phosphorus 046, 156, 430
photocatalytic reactor 155
pickling liquors 421
Picknett model 002
plant injury
- air pollution 218, 231
- aluminum 007, 242
- birds 136
- drought 242
- fluoride 027
- napthalene 014
- organic contaminants 014
- ozone 217
- PAHs 141, 204
- photomodified PAHs 141, 204
- uranium 021

plant membranes 027
Plastic Lake 304
policy development 138, 174
polishing ponds 173
pollution transport and movement
- air 004, 005, 009, 011, 017, 019, 020, 023, 147, 148, 150, 153, 233, 238
- soil 090, 091, 095, 099, 100, 101, 105, 161, 171, 182, 184, 188, 205
- water 036, 037, 039, 047, 077, 118, 154, 184

Port Dover 296
potable water 041, 189, 422
potatoes 217
Precambrian Shield 038, 066
precipitation samplers 212
preconcentration sampler 409
PROTEST 062
Pseudomonas aeruginosa 037, 063, 139
psychosocial impacts 129, 413
public health units 146
pulmonary carcinogens 142
pulp and paper mill effluent 050, 064, 078, 164, 336

R

rainbow trout 045, 050, 082, 084, 086
rainbow trout bioassay 082
rainbow trout culture 045, 084
rats 280
Rayox enhanced oxidation product 427
rechargeable batteries 435
recreational water 156
recycling 131, 296, 434, 436, 437
red spruce 007
refuse derived fuel 366, 385
Remedial Action Plan - Bay of Quinte 197
remote sensing 028, 038, 059, 074, 249, 316
respirable particulates 133
respiratory health 208, 236
retractable adsorbents 060, 410
reverse osmosis 097, 302, 376
Rideau River 262, 264, 265
road dust suppression 341
roofing shingles recycling 436
Rural Beaches Program 037, 085, 156
rutabaga 218

S

sanitary waste 318
Sault Ste. Marie 006
Scenedesmus 329
sediments 070, 081, 114, 156, 172, 176, 194, 294, 298, 299, 310, 320, 331, 433
selenium 120, 179
septic tanks 054, 188
sewage and sludge handling pumps 428
sewage lagoons 270
sewage sludge 157, 194, 356, 384, 428
sewage treatment 077, 124, 160, 173, 295, 428, 430
sewerage facility management 307
sewers 167
skin cancer 151
slag dump 094
sleep disturbance 213
slow rate infiltration 090
slow sand water filtration 033

smoking 228
sodium hypochlorite 185
sodium napthalenide 348
Soil Chemical Exchange and Migration of Radionuclides model 205
soil ingestion 200
soil loss 046
soil retention of heavy metals 101
solidified fabric filter ash 386
solid phase extraction 191
solid waste integrity 365
solid waste stabilization 108
sport fish 031, 331, 393
stack sampling 230, 232
standard reference materials 117
steam explosion deinking 432
sterile insect release method 415
storm sewers 318
stormwater management 075, 175, 262, 264, 265, 318
Streptococcus faecium subsp. *casseliflavus* 160
Sudbury 017
sugar maple 007, 008, 022, 028, 143, 242
sugar maple decline 008, 028, 143
sulphates 017, 031
sulphur cycle 042, 304
sulphur dioxide 012, 214, 232
supercritical fluid extraction 121
surface water contamination 181, 188, 287
- from groundwater 081, 094
surface water treatment 425
surfactants 139
suspended sediments 039, 074, 077
sustainable development 132, 197
Sutton concept sewage treatment system 173
sweetcorn 218

T

TAGA 3000 024
tailings 107, 340
termites 127, 202
Terrace Bay 336
Thames River 301
tetrachloride 089
tetrachlorobiphenyl 139
tetrachloroethane 052
tetrachloroethylene 060
Tetrahymena vorax 082
textile dyebath effluent 096
thiocyanate 035
tile drainage 036, 083, 161, 172, 289
TILE model 036
timber management 074
tin 113
toluene 089
Toronto 006, 019, 040, 137
toxic gas emergency 237
toxic organics 157, 393
trace atmospheric gas analyzer 024
trace gases 005, 248
trace gas measurement 024, 248
trace metals 010, 068, 077, 123, 317, 190, 196
trace organic compounds 029, 281, 399
train vibrations 015
transformer oil 348
transgenic plants 140
trichloroethylene 100
trichlorophenols 267
trihalomethanes 425, 426, 429
trout farm effluent 274
tunable diode laser technology 005, 153, 219, 248

U

unguaged watersheds 055, 165
unionid clams 053
uranium 021 346
uranium mining 351, 352, 353
UVB radiation 151
UV light 204
UV light photolysis 158

V

VBF 185
vector scoring system 240, 241
vegetation establishment 088, 377
vibrations 015
viruses 010, 140
Vitrokele™ 419
volatile halogenated organics 189
volatile organic compounds 013, 057, 149, 167, 182

W

walleye 257
waste combustion 385
waste disposal sites 384
waste incineration 386
wastewater aeration 429, 431
wastewater collection systems 167
wastewater treatment 072, 189, 288, 422, 428, 429, 430, 431
water demand management 128
water management 307
water quality assessment 051, 311, 328, 333
water quality guidelines 056, 071
water quality management 284
water quality modelling 301

water runoff 046
water sampling 057
watersheds 169, 172, 304
water treatment plant 321
WATQUAS 051
weeping bed disposal system 073
Welland River 176
whey 291, 302
white sucker fish 064, 077, 078, 297
white fish 078
wood combustion 025, 245, 253
World Wildlife Fund 048

X

X-ray fluorescence 026

Y

yellow perch 300

Z

zebra mussels 053
zinc 101, 297, 320
zinc recovery 420
zooplankton 067, 317, 372, 373
Zygnemataceae 065
Zygnematacean 337

Keyword Index

(Awareness)

Codes *439-508* Miscellaneous Grants Projects
509-557 Funds From The Cleansweep Lottery Projects

A

acid rain 450, 463, 480, 487, 504, 510, 522, 524, 539, 543
advisory networks see resource services
agricultural pollution 554
agriculture 551, 552, 554
algal growth 550, 551, 552
Alternatives magazine 461, 513
aquatic ecosystems 522

B

BARK 463
Bay of Quinte 514, 550
biotechnology 536
Black Ash Creek 552
books see reports
Brady Lake 549
brochures see literature

C

calendar 512
Canadian Coalition on Acid Rain 487, 510
Canadian Environment Industry Association 547
climate change 535
common loon 487, 510
composting 451, 465, 469, 499, 538
conferences
- acid rain 480
- Canadian Environment Industry Association 547
- composting 451
- construction industry 447
- drinking water 443, 531
- educational requirements of students 445
- energy 451
- environmental issues (general) 441, 444, 448, 456, 473, 500, 532, 542
- forestry 526
- global warming 444
- groundwater contamination 443
- industry and business 452, 457
- legislation 453
- limnology 531
- MISA 546
- native perspectives 442, 446, 455
- organization of 545
- pollution 444, 546
- rainforests 444
- recreation 526
- recycling 451
- science and technology 440
- Soviet Union 454
- sustainable development 439, 441, 443, 453, 455, 457
- vehicle emissions 480
- waste management 439, 444, 451
- water management 531
- wildlife 526
- zebra mussels 531

construction industry 447, 555
Costa Rica 502

D

deforestation 518
Don River 556
drinking water 443, 531

E

Earth Day 459, 470, 473
Earth Week 477
educational requirements of students 445
employment opportunities 497
energy conservation 451, 484, 509, 512, 519, 520, 523, 524
Envirohome 506
environmental issues (general) 441, 444, 448, 449, 456, 464, 466, 469, 473, 477, 478, 481, 488, 490, 491, 493, 500, 505, 506, 513, 519, 523, 524, 525, 527, 532, 540, 541, 542, 544, 545

Environment Week 473
erosion control 551, 552, 555
Essex 491

F

festivals and fairs
- acid rain 450
- employment opportunities 497
- environmental issues (general) 470, 500, 540
- food safety 450
- hazardous household wastes 450
- organic gardening 450
- recycling 450

films and videos
- acid rain 487, 510, 522
- aquatic ecosystems 522
- Bay of Quinte 514
- common loon 487, 510
- Don River 556
- energy conservation 509, 520
- environmental issues (general) 502, 520, 523
- garbage 520
- groundwater 522
- legislation 467, 487, 510
- Oak Ridge Moraine 556
- sulphur dioxide 510
- surveillance 467
- sustainable development 440
- waste reduction 509
- water conservation 509
- water cycle 522
- water pollution 522

fish 551, 552, 553, 555
food safety 450
forest management 489
forestry 526

G

Gananoque River 535
garbage 521
Geographic Information System 476
global ecology 535
global warming 444, 471, 511, 518
greenhouse gases 511
groundwater 522
guides see literature

H

Hamilton 449
Hamilton-Wentworth region 498, 508
health and the environment 460
household products 450, 465, 469, 499, 518, 519
Hudson Bay 516
hydroelectric development 516

I

industrial waste 534
industry and business 452, 457
information packages
- acid rain 522
- aquatic ecosystems 522
- Bay of Quinte 550
- composting 465
- Earth Day 459
- environmental issues (general) 474, 478, 481, 523
- groundwater 522
- hazardous waste 465
- recycling 465
- Tree Day 521
- waste management and reduction 465
- water cycle 522
- water pollution 522

information services see resource services
inventory of environmental components 476

J

James Bay 516
Junction Creek 548

L

land use management 476, 498
Law Day 529
legislation 453, 467, 479, 480, 485, 487, 489, 504, 510, 529
limnology 531
literature (see also reports, newsletters)
- acid rain 543
- composting 538
- Earth Day 459
- energy conservation 484, 519, 520
- environmental issues (general) 505, 520, 544
- garbage 520
- forest management 489
- household products 519
- industrial waste 534
- legislation 489
- mercury 534
- ozone 543
- recycling 484, 538
- sustainable development 515
- 3R's 484

- tours 501
- waste management 501, 538
- waste reduction 484, 519, 538
- water conservation 484, 519
- workplace 484

London 460

M

magazines see newsletters
mercury 534
MISA 546
monitoring programs
- acid rain 463, 479, 480, 504, 539
- climate change 535
- global ecology 535
- legislation 479, 480, 504
- ozone 504
- vehicle emissions 504

municipal water and wastewater management 462

N

native perspectives 442, 446, 455
networks 449
newsletters (see also reports)
- Alternatives 461, 513
- composting 499
- Earthroots 516
- environmental issues (general) 513
- hazardous household wastes 499
- hydroelectric development 516
- sustainable development 461
- 3R's 499
- Tree Day 521
- Waste Less Times 499
- waste management 499

Niagara Falls 476
Niagara River 476
nutrient enrichment 551, 552

O

Oak Ridges Moraine 486, 556
organic gardening 450
ozone 504, 543

P

pamphlets see literature
PCBs 495
Peterborough 492
plays see theatrical and musical productions
pollution 444, 524, 533, 546
publications see literature, newsletters, reports
public outreach campaigns
- Envirohome 506
- environmental issues (general) 464, 473, 481, 488, 491, 506, 524, 525, 541
- global warming 471, 511
- greenhouse gases 511
- Oak Ridges Moraine 486
- PCBs 495
- science and technology 508
- sewage 530
- stormwater 530
- sustainable development 482, 494
- 3R's 503
- tree planting 471
- waste management 525
- waste reduction 503

R

radio 464, 493
rainforests 444, 528
recreation 526, 551
recycling 450, 451, 465, 469, 538
Recycling Week 505
Remedial Action Plans
- Bay of Quinte 550, 557
- Black Ash Creek 552
- Don River 556
- Severn Sound 551, 554
- Thommy Thompson Park 553
- Toronto 555

reports (see also newsletters)
- biotechnology 536
- forestry 526
- land use management 498
- legislation 479, 485
- municipal water and wastewater 462
- recreation 526
- sustainable development 458, 469
- waste management 496
- water conservation 462
- water management 462, 498
- wildlife 526

resource centres see resource services
resource services
- Bay of Quinte 557
- environmental issues (general) 466, 472, 517
- environment and health (London) 460
- sustainable development 480, 492
- 3R's 537

S

science and technology 440, 508
SEEDS 474
Severn Sound 551, 554
shoreline destruction 550
shoreline development 549
slide collection 527
Soviet Union 454
stormwater 530
Sudbury 487, 510
sulphur dioxide 487, 510
surveillance 467
sustainable development 439, 440, 441, 444, 454, 455, 457, 458, 461, 468, 482, 492, 494

T

television series 520, 524
theatrical and musical productions
- composting 469
- deforestation 518
- environmental issues (general) 469, 477, 478, 490, 518, 540
- global warming 518
- hazardous waste 469
- household products 518
- industrial waste 534
- mercury 534
- pollution 533
- rainforest 528
- recycling 469
- 3R's 533
- toxic chemicals 518
- waste reduction 518
- wildlife 533

Thommy Thompson Park 553
3R's 484, 499, 503, 524, 527, 533, 537
Toronto 501, 555
toxic chemicals 518
transportation 483
Tree Day 521
tree planting 471, 548

V

vehicle emissions 475, 480, 504

W

Waste Less Times newsletter 499
waste management and reduction 439, 444, 451, 465, 484, 496, 499, 503, 509, 518, 519, 525, 538
Waterloo region 468
water conservation 462, 484, 509, 519
water cycle 522
water management 462, 498, 499, 531
water pollution 522
wetland creation 553
Windsor 491
wildlife 526, 533
workbooks see literature

Z

zebra mussels 531